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PNR 313

Pioneer

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Viewpoint

As you may have noticed, this month I've had the opportunity to review Joycom's new MPIO personal MP3 player. This is in addition to the Pine D'music player I looked at last month, and the Rio MP3 player I reviewed six months before that.

Doing these reviews has made me think about MP3s, and after talking to a number of people as well as reading everything I could find on the subject, I've come to realise that a number of myths that have grown around this recent file format.

Exploding some myths about MP3

You can download any song you want off the Internet in minutes:
There are hundreds of fancy MP3 search engines out there, but when it comes to actually downloading a song, 90% of the sites are either dead, or require you to click on dozens of remarkably seedy banner ads before you can download — assuming you can actually find the song you are looking for.

A goodly proportion of MP3s end up being on FTP sites, which present their own set of problems including the need to obtain user names and passwords via email (and thus sign up for a lifetime's supply of spam).

Downloading songs off the Internet will kill the music industry:
If you go to the legal MP3 sites, you'll find hundreds if not thousands of artists promoting their music. Rather than short-circuiting the distributors, the MP3 format gives artists a chance to provide the public with a high-quality, cheap demo of their albums, and the user a chance to try before they buy. And what do they buy? The CD of course. It worked for software, why shouldn't it work for music?

You can email songs to your friends:
Yeah, right. *You* start emailing 4MB attachments to your friends, and see how long they continue to be your friends...

MP3s will replace CDs as the music format of the future.
Just as the computer has replaced the book, and the newspaper, and working for a living, and having to think and... Oh, and of course, music too. Silly of me.

MP3s give CD-quality sound:
They don't. MP3s give more than adequate quality sound if you're using earphones, or cheap tinny PC speakers, but run an MP3 and the original CD recording side-by-side on a halfway-decent set of speakers and there's no comparison whatsoever. MP3 is lossy compression, ergo.. you lose stuff. Simple.

Well, that's my opinion, anyway. MP3 is a great music format, but I feel that it has been hyped up out of all proportions. I'd be interested to hear from anyone who has anything to add to the subject — either for or against.

Graham Cattley

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ADVERTISING INDEX

...on the cover

Make programmable robots and droids with Lego's innovative Mindstorms construction set. It's fun and educational for big kids, plus little kids like Max Evans - our 'cover kid' for the month.
(Photo by Michael Pugh)

Contents

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Somebody up there likes you. Like guardian angels, the Global Positioning System satellites help to land planes safely. Find ships that are lost at sea. And get you and your rental car back to civilization when you've taken an ill-advised shortcut. Test systems from Agilent make sure every GPS satellite works once it's up there. It's good to have friends in high places.

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WHAT'S new

in the ever-changing world of electronics

The Cyclone

Ever wanted one of those spherical destroyer droids from *The Phantom Menace*? The ones that roll down corridors into battle and then unfurl into a battle droid with high power laser cannon and force fields?

Well, we can't offer you the unfurling, cannon, or force fields, but the new Cyclone from World of Robotics scoots along, dodges round corners and spins on its axis just like the real thing.

Slightly larger than a tennis ball, the Cyclone can be steered around under the command of a radio remote control. Its spherical shape and independent rim wheels allow it to instantly spin, swivel, and roll forwards, backwards, left or right. The remote control system operates over six channels, so you can run races, mazes or obstacle courses with your friends, and the clear plastic shell provides an interesting view of the mechanics and electronics inside.

Priced at $170, the Cyclone would make an ideal Christmas gift, and is available from World of Robotics, 110 Mt. Pleasant Rd, Belmont, Geelong, Vic 3216. Phone (03) 5241 9581, or email **frances@mail.austasia.net**.

Latest DVD movie releases

Columbia Tristar Home Video and Universal Pictures have now released the following movies in Australia on DVD:

The China Syndrome (Thriller)	1978
Futuresport (Sc/Fi)	1998
8mm (Thriller)	1998
The Mask of Zorro (Collector's Ed.)	1998
Ghostbusters (Collector's Ed.) (Comedy)	1984
Ghostbusters II (Comedy)	1989
It Could Happen to You (Comedy)	1994
Escape from Absolom (Sc/ Fi)	1994
Sudden Death (Thriller)	1995
Kindergarten Cop (Comedy)	1990
Psycho (Horror)	1960
Adventure of Baron Munchausen (Adventure)	1988
Patch Addams (Collector's Ed.) (Comedy)	1998
Christine (Horror)	1983
Solo (Sc/Fi)	1996.

3-in-1 Bicycle Computer

The new Bicycle Computer from Dick Smith Electronics has twelve functions in all, including maximum speed alarm, average speed, 24 hour clock time, trip distance and time, and an alarm clock that all appear on the LCD face.

The compact unit is easily attached to the bicycle frame with the supplied bracket and the sensor provides accurate information while cycling.

The 3 in 1 Bicycle Computer is available at a retail price of $29.85 from all Dick Smith Electronics and PowerHouse stores, or via mail order by calling Dick Smith Electronics Direct Link on 1300 366 644, or visit the website at www.dse.com.au.

New entry-level digital video camera

Panasonic has released the NV-DS11, a new entry-level digital video camera which features a powerful 20x optical zoom and a 40x/400x digital zoom, a 2.5 inch (63.5mm) colour LCD monitor, a super image stabiliser and versatile manual functions. In addition, the DS11 makes two hours continuous digital recording available to consumers, using an 80 minute tape (in LP mode).

The new digital video camera also includes functions designed to give more control to the semi-professional videographer — including manual focus control lever, white balance, iris and gain control.

Other features include Panasonic's quick charge battery system, DV in/out terminal, Digital Still Picture Terminal, playback digital zoom (up to 10x), and digital effects for recording and playback.

For excellent results when shooting, the Super Image Stabiliser incorporates an extra-capacity 570,000-pixel CCD — this suppresses hand shaking, especially when shooting scenes in the tele setting, yet maintains excellent picture quality.

The DS11 is priced at $2549 (RRP) and is available from leading electrical retailers. For more information contact Panasonic Customer Care on 132 600.

New laser faxes from Panasonic

Panasonic has released three new facsimile machines — the UF885, the UF595 and the UF-585. These plain paper laser machines offer a range of upgrade options, from additional flash memory, to network compatibility.

The UF-885 is designed for large organisations and departments, or businesses with high-volume faxing requirements; while the UF-595 and UF-585 are suitable for medium-sized businesses, the executive desktop, or acting as powerful solutions in the small office. The three machines can all be upgraded with options such as extra flash memory, a parallel port interface for PC printing and scanning, and a LaserFax PC/LAN interface for connection to office networks.

The machines are supplied standard with 1MB (80 pages) of memory. Panasonic's optional flash memory cards allow data to be retained even during power blackouts, and ensure continuous transmission and reception of large documents. 1MB (80 pages), 2MB (160 pages) and 4MB (320 pages) upgrades are available for the UF-595 and 585, while the UF-885 can be upgraded to a massive (640 pages) of memory.

The optional parallel port interface kit (including TWAIN driver) allows a facsimile to be connected to PC for high-quality printing, as well as scanning. Documents printed directly from PC to facsimile can be output at 600 x 600 dpi. The UF series of faxes are priced from $1999 (RRP) and is available from leading electrical retailers. For more information contact Panasonic Customer Care on 132 600.

Compact, super bright projector

Mitsubishi says its new LVP-X300U Multimedia/Data Projector is the brightest projector for its size, a compact 5.9kg, with features bringing a new class of projection skills to multimedia presentations. For example there's no need to dim the room lights for your presentation, as the unit projects brilliant, clear images under typical indoor light conditions, with its powerful 2000 ANSI Lumens projection system.

The unfortunate occurrence of distorted, jagged images caused by projecting images from an angle to the screen has been eliminated with the LVP-X300U's Digital Keystone Correction System. It corrects the slight trapezoid effect within a range of 15 degrees, resulting in a picture perfect presentation.

You can simultaneously run a Powerpoint presentation and a video on the one screen through this projector, creating dynamic image presentations, with the Dual Source Multi Display feature. The moving images can be displayed one within the other in a PIP (Picture In Picture) in any corner of the screen.

For even more stunning, realistic video playback, the LVP-X300U also features Cinema Mode Function, known as 3-2 PullDown detection circuitry.

For more information contact Mitsubishi Electric on (02) 9684 7777

WHAT'S new in the ever-changing world of electronics

High-end digital AV Surround Amplifier

Denon's new AVC-A1D surround sound amplifier is packed with virtually every desirable feature for outstanding home theatre and music surround sound enjoyment. It includes Dolby Digital, DTS (Digital Theatre System) and Dolby Pro-Logic decoding, THX 5.1 Ultra, DSP with wide-screen, five channel stereo, classic concert, rock arena, jazz club, super stadium and matrix DSP modes, multi-room operation, onscreen graphics, component video switching, 11 analog and 9 digital audio inputs, 6 composite/S-video inputs, and two component video inputs.

Dolby Digital, DTS decoding, and Lucasfilm THX Ultra post-processing, entirely in the digital domain, are combined with the innovation of Denon's Dynamic Discrete Surround Circuit (DDSC) to provide the first AV component that delivers optimised surround sound for both movie sound tracks as well as discrete multi-channel music surround. A proprietary 24-bit, 96kHz Digital Interface Receiver (DIR) preserves the integrity of the music, and further enhances sound quality.

Both these Digital Surround Sound technologies are further enhanced by Lucasfilm's THX Ultra technology, resulting in AVC-A1D meeting over 300 requirements to satisfy this new Lucasfilm designation. Meeting all future surround sound requirements, the AVC-A1D offers 8 channel (7.1) inputs and 8 channel pre-amp outputs.

The AVC-A1D has an RRP of $5,680 and is covered by a two-year parts and labour warranty. For further information on this or any other Denon product call AWA Audio Products on 1 800 642 922 or enquire at **info@audioproducts.com.au**

Compact S-VGA projector has high output

The CP-S840 is a lightweight projector of only 4.45kg, easily movable between offices and remote sites. Small as it is, the new CP-S840 boasts levels of brightness and advanced features previously found only in larger desktop units.

Featuring true S-VGA resolution (800 x 600) and using a three layer 0.9" polysilicon active-matrix TFT panel, the unit is capable of fine re-sizing both XGA and VGA images so that non-S-VGA data is reproduced accurately.

With a long-life 150W UHP lamp and advanced optics, the CP-S840 produces an overall brightness level of 800 ANSI Lumens, one of the highest brightness figures obtainable in this price range and size of projector. It also features a wide range of inputs and outputs to cope with today's multimedia needs, including RGB inputs for connection of two PCs, an external monitor connection and a video player input plus serial control terminal. High power stereo speakers are built into the small case for outstanding aural impact. One very nice feature of the new projector is 'freeze-frame' or the ability to lock an image on screen while changing input connections ensuring a smooth interruption-free presentation.

The Hitachi CP-S840 is 248 x 100 x 330mm in size and only weighs 4.45kg. It is available from Hitachi resellers around Australia at an RRP of $8995 including tax.

New portable DVD player from Panasonic

Panasonic's new DVD-L50 portable DVD (digital video disc) player has a 5-inch LCD screen and built-in stereo speakers. It's designed for viewing DVD discs anywhere, anytime, and can also be connected to a TV at home.

The DVD-L50 replaces Panasonic's DVD-L10 portable DVD player. Panasonic has further reduced the size of the player to a compact 140 x 151.5 x 37.7mm, and the unit now weighs just 640 grams. Player features are controlled with a new, slim 'credit card' remote.

Maximum battery playback time has also been increased from two to three hours, and the new lithium ion battery is smaller and lighter. The DVD-L50 also offers the convenience of a built-in battery recharger, combined with the multi-voltage AC adaptor.

The player has a 280,000-pixel screen with a 16:9 aspect ratio to display the entire screen image. To handle standard images or letterbox formats recorded at a 4:3 aspect ratio, the user can select Normal, Full or Zoom display modes.

The DVD-L50 has digital optical output for connection to an external DTS or Dolby Digital decoder for 5.1 channel digital surround sound. It also offers movie enthusiasts new features — Dialogue Enhancer and Advanced Virtual Surround Sound (VSS) — to boost the listening experience with Dolby 5.1 channel discs.

The new DVD player is available from leading electrical retailers, with an RRP of $3099. For more information contact Panasonic's Customer Care on 132 600.

New Ericsson T10s is so cool, it's hot!

Ericsson's coolest mobile phone has hit Australian shelves, and is set to melt the

hearts of mobile phone users everywhere. The Ericsson T10s is a fun, easy to use mobile phone, offering all of the latest mobile phone features in this season's freshest colours.

These eye catching phones are available in a range of deliciously cool colours, including Juicy Blue, Shocking Pink, Mustang Yellow, Funky Purple and Crispy Turquoise — Perfect for those who want to make themselves seen as well as heard!

The Ericsson T10s includes all of the features you'd expect: discreet vibrating alert for those 'do not disturb' moments, a full three line graphic display, dual band functionality and Enhanced Full Rate (EFR) speech clarity for maximum call quality. The T10s also features seven pre-programmed ring signals along with two programmable ring signals, so your phone can be as individual as you are! You can even send short text messages to your friends. The Ericsson T10s is available nationally at all dealers and retail outlets, or call 1300 650 050. Or visit **www.ericsson-mobiles.com.au**.

69cm TV has Super-Flat screen

Hitachi's new C29-F100 is a 69cm television incorporating many new advances in screen technology, including a perfectly flat and large screen that delivers a perfect image in any conditions found at home or work.

Annoying reflections so common with conventional TVs are a thing of the past with the C29-F100, because Super-flat screens ensure wide viewing angle and the maximum in viewing pleasure. Hitachi has also incorporated many new features in this television to enhance images. Foremost is 'velocity modulation' that sharpens image edges, resulting in better definition between light and dark segments. The use of advanced Comb Filter technology also separates colour from luminance signals, resulting in clearer pictures with really vivid colours.

One of the 'must haves' with televisions of this quality is an aural as well as visual experience. For those not blessed with a home surround sound system, the new C29-F100 includes spatialiser circuitry for spectacular 3D surround sound effects. This recreates the effect of an elaborate multi-way speaker and amplifier set-up simply using the TV's own built-in 7W stereo speakers.

The Hitachi C29-F100 measures 696 x 491 x 613mm and weighs 44kg. It is available from leading retailers at an RRP of $1699 including tax.

Sony's 'complete Minidisc solution'

Sony Australia has released its all-in-one Minidisc solutions pack, the MD Solution. The package offers users all they need as a first time MD user ranging from home use to music on the move. The package includes:

- Mini Disk Deck MDSJE330, offering digital editing features; track and disc titling facility; 6 second Time Machine Recording; multiple playback modes (shuffle/programme/repeat/continue); jog dial; digital record level control; optical digital inputs; FL display; remote control.
- MD Walkman MZE33N, offering vertical compact design; LCD stick-type remote; 3-way battery compartment (1 x 'gum type' rechargeable/1 x AA rechargeable or 1 x AA Alkaline); up to 9.5hrs playback; 10sec shock resistant memory; digital Mega Bass; auto mono playback for mono recordings; carry pouch; AVLS (Automatic Volume Limiting System); available in Silver (MZE33N or blue (MZE33L).
- 3 x MD discs MDW74A
- Headphones MDRG52LP
- Car adaptor CPA9

The Minidisc format combines the recordability of tapes with the quality and speed of compact discs. The clear digital sound users have come to expect from compact discs is delivered in the tiny, durable Minidisc format that can be recorded over and edited, time and time again.

For more consumer information contact Sony Consumer Information Centre on (02) 9878 9712. ❖

Lego Mindstorms

-more than just kid's stuff

by Rob Evans

Famous for their advanced Lego Technics construction systems, Lego have now moved into the wonderful world of programmable robots. Based on a fascinating combination of standard plastic building bricks and microprocessor technology, Lego's Robot Invention System lets kids design and program their own, real, autonomous robots. Lego had kindly sent us a kit, and being a big kid at heart I jumped at the chance to take it home for a test play...

The fight over parts had been going on since we opened the box, but the superiority of a seven year old's canny was beginning to show. Young Max was now ferreting away the most interesting Lego pieces for his own project faster than I could add them to mine, and our competing ruckus was clearly disrupting the whole household. Suffice to say, in the face of such dogged determination I really had to yield, leaving my construction plans on the back burner for the moment while Max eagerly beavered on...

All this fuss about plastic Lego blocks? Ahh, we're not talking about just *any* Lego construction set here — this is Lego's 'MindStorms' series; a sophisticated, programmable robot construction set that fires the imagination's of big and little kids alike (hence the father/son squabble).

Developed through collaboration between the Lego group and Massachusetts Institute of Technology (MIT) over several years, the MindStorms Robotics Invention system contains more than 700 Lego pieces (including lots of lovely cogs and wheels), a number of 'sensor' blocks (touch and light), two motors, plus the brains of the outfit; a processor-equipped oversized Lego block called the RCX. The kit can be used to make all sorts of functional robots, including ones that can 'feel' their way around, react to changes in light, or even follow a line marking. And the best bit is it's fully programmable via the supplied PC software and an infrared link.

The Robot Invention System is intended for children from the age of 12 years and

up, but as I found, if you have any interest in constructing functional machines or robots, the kit is certain to get the creative juices flowing. Within an hour or so we had managed to build a Star Wars-inspired 'Pod racer' (seven year old Max), a three-wheeled droid (his twelve year old sister), and a track-wheeled battle tank with contact sensors (me). The following hour delivered several other weird and wonderful constructions, and at that stage we'd only used the RCX controller's built-in programs, rather than attempting our own.

RCX: Lego's brainy brick

This chubby yellow/grey brick is the core of the MindStorms series, and is an impressive example of how microprocessor technology can be brought down to a practical level, where even young children can understand its functions and programming concepts.

Based on an 8-bit Hitachi processor, the RCX brick is equipped with 16K of ROM, 512 bytes of firmware in SRAM, and 32K of external SRAM for user code. Kids couldn't care less about this of course the end - result is that the brick has three connectors for input sensors, three connectors to drive output loads such as motors, and offers an easy to understand LCD display panel and control button arrangement.

A fine example of the thought that's gone into the RCX brick's design are the electrical connectors used for both the inputs and outputs. Since the Lego's interlocking blocks form a natural plug and socket, the designers have simply included a set of small electrical contacts in a standard four-way block arrangement.

Six of these electrical 'plugs' are mounted on the RCX module's front panel (three inputs and three outputs), while the flying leads from the motor units and sensors are terminated in a matching 'socket'. It's interesting to note that the contacts are arranged in such a way that an electrical connection is made regardless of the plug's orientation, so a motor or sensor will always work when plugged into the RCX. This scheme can mean that the motor ends up rotating the wrong way for the job at hand, but in that case you just plug it in the opposite way around — even young kids have no trouble with that concept.

Programs are downloaded from the PC to

Lego, the institution

The ubiquitous plastic Lego blocks were part of childhood for many of us — except perhaps older readers, where fond memories of the metal-based Meccano sets may come flooding back — yet it may come as a surprise to learn just how long the name Lego has been associated with constructive children's play.

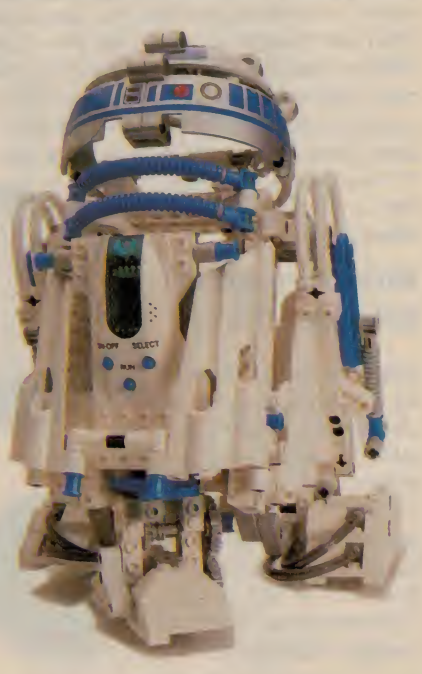
The Lego group was founded in Denmark by one Ole Kirk Christiansen, who began making wooden toys in 1932 then later (around 1934) chose the name LEGO through a contraction of two Danish words 'eg' and 'godt' — which apparently translates as 'play well' in his native tongue, or 'I put together' in Latin. Ten years later Christiansen developed the trademark interlocking plastic blocks that we know so well today, and a dynasty was born.

Jumping ahead another fifty years, Lego introduced their MindStorms programmable construction kits to the US and UK markets in 1998, after around ten years of development with the renowned media labs at MIT. It's perhaps no coincidence then, that the icon-based graphical programming language used in the MindStorms software closely resembles Logo, an educational language developed at MIT by artificial intelligence pioneer Dr Seymour Papert.

A respected institution like MIT helping to develop children's toys? Too right. Consider Anthony Fudd, 27, a Lego MindStorms 'master' model builder who's studying mechanical engineering and architecture at MIT, as well as taking his Lego robots creations on tour through the US. Using MindStorm components, Fudd (pictured here) has apparently made a card dealing robot, a virtual reality robotic arm, plus a copy machine that uses a light sensor to scan the image then a mechanically-driven felt pen to reproduce it at the other end. Not bad for a kid's toy based on an 8-bit microprocessor...

Keeping in theme with the cutting edge of technology-based toys, Lego have recently introduced their MindStorms-dedicated website at (not surprisingly) www.legomindstorms.com. Here you can join robot building forums to discuss new ideas or post questions, check out information on other robotic project designs, upload your own designs so others can enjoy your expertise, plus learn the fundamentals of design though the hints and tutor pages. If you're really ambitious, you can even download the RCX Technical Reference and use it to develop your own programming system. ❖

Below is a shot of the Mindstorms programming screen. Function blocks simply 'click' together to create your program, which is then downloaded into the RCX control module.



surprisingly — very well thought out and comprehensive, and offers a series of narrated training sessions to help you become familiar with the programming system.

These interactive training tutorials are a work of art in themselves. The concepts of logic and program design are explained in clear language, and most points are visually demonstrated during the narration using both still and moving images. As it turned out, the narrator was a big hit thanks to his strange but compelling clipped speech pattern, plus his corny comments at the end of each lesson such as "Cool", and "You're brilliant!" Come to think of it, the voice may well have been electronically generated, in keeping with the robotics theme...

The RCX brick talks to your PC via a full-duplex infrared link, courtesy of a battery-powered IR module.

When it comes to creating your own RCX 'code', the system offers a intuitive, graphically-orientated interface that allows you to drag and drop function icons (configurable blocks of code, in effect) onto the screen as they're needed. The process is much like the physical act of assembling Lego bricks, where logic and sensor blocks icons are connected together in a stack to construct a program. It's a quite limited 'instruction set' as you might expect, but it has enough flexibility to create RCX programs for quite elaborate robots or machines.

Best of all though, the RCX programming system does a great job of introducing the concepts of creating code to anyone that hasn't programmed before — young or old. Instant gratification isn't a problem either, since the RCX brick can be programmed via a simple but effective little infrared link system, which uses a battery-powered IR module to communicate via a small IR window on the upper end the brick. The module itself talks to the PC through a standard serial port, where the software can not only send information to the RCX brick (download programs) but also read status data back from the brick (the voltage at its inputs, plus the logic state at its outputs). Just like the other components in the MindStorm kit, this setup has been well thought out, with nice little 'confidence' touches such as an IR activity indicator LED in the transceiver module, plus a confirmation trill (nothing as mundane as a beep here) from the RCX to indicate that it's received a download — somehow, it always seems pleased about that.

Kid-compatible programming

With the Robot Invention kit it seems that the more construction projects you complete, the more ambitious your plans become. This invariably leads to a need for more elaborate programs than those preloaded into the brick, and a foray into an RCX programming session on the PC. The supplied software is — not

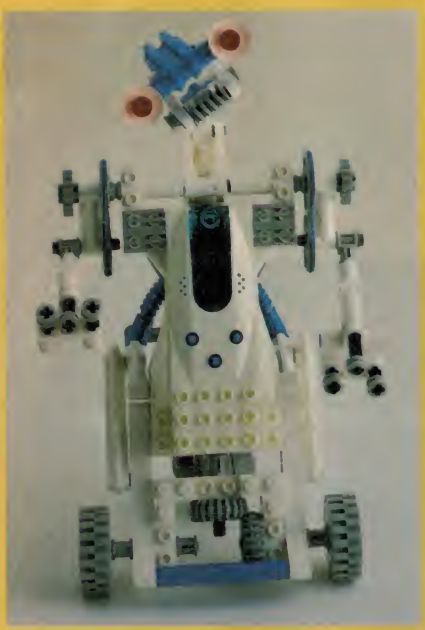
Mindstorms Droid Developer kit — less ambitious, but great fun.

It's been very difficult to avoid the whole hoopla surrounding the most recent Star Wars commercial extravaganza ('Episode 1'), but like it or not, it's certainly captured the target audience in fine style. No doubt through an extraordinarily expensive licencing agreement, Lego are now offering a Droid Developer kit as a subset of their MindStorm series, which gives kids the opportunity to build their own Star Wars creations. If you at all doubt the sense of this marketing move, just try saying "I have a robot droid kit you can build" to a ten year old boy, and check out the reaction...

The Lego Mindstorms Droid Developer kit is intended for children above the age of nine years, and has all the parts needed to build that old stalwart droid R2-D2, or new to the recent film, one of the sinister battle droids. Featuring more than 600 parts, the kit is arranged to cater for three levels of building difficulty so children can move up to more taxing projects as their skills improve. In line with the kit's theme, this means starting as an Apprentice, moving on to a Jedi Knight, and graduating as a Jedi Master - quite a career path.

Along with a lower price tag and more defined construction process, the main difference between the Robotics Invention system and the Droid Development kit is in the micro-based controller. While the Robotics kit has the sophisticated RCX programmable module, the Droid features a neat little non-programmable unit called the Micro Scout. This has seven pre-defined programs (or behaviours, as Lego likes call them), plus a built-in motor and a light sensor. In this case, the sensor is used to pick up light from a torch beam, which then changes the droid's action in a manner defined by the selected Micro Scout program — for example, Program 4 tells the droid to move when it sees a constant light, but change direction when it detects two flashes.

The Micro Scout is a very neat solution to the needs of younger builders, who enjoy the sophistication of a programmed control system but aren't really in a posi-



tion to program the device, or for that matter, deal with an array of input/output connectors. The 'Scout is a fully self contained system, so the constructor only needs to mechanically integrate it with the model, then connect the drive train to its motor output 'socket'.

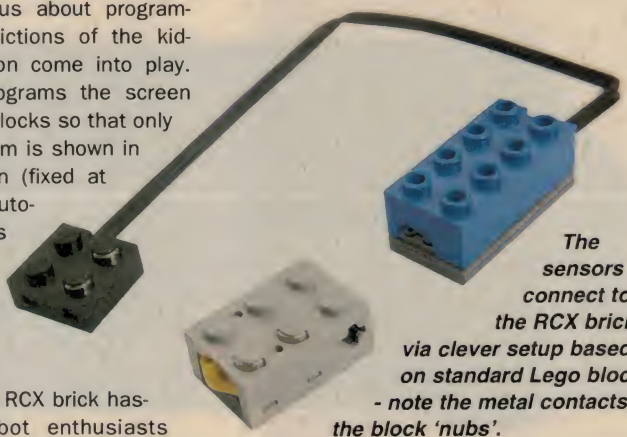
As with the Robot Invention System, the quality of both the components and documentation is nothing less than excellent. Young constuctors are helped through the whole path of building and using their droid by Lego's 'constructopedia' book and CD instructions, which lead you though the process by a series of very accurate dimensional diagrams. The instructions are completely based on these colour diagrams by the way, so even a child without reading skills could manage to build a fairly complex droid.

Also, since the Droid Development system is a subset of the Lego MindStorms products, the parts are fully compatible with other MindStorms kits such as the Robot Invention system, plus of course, your existing cache of Lego blocks. This leads to all sorts of possibilities for droid construction, including the ability to replace the low-level Micro Scout controller with the fully programmable RCX smart brick from the Robot Invention system — then you can really 'use the Force' with your Star Wars droids.

The Lego Mindstorms Droid Developer kit has a recommended retail price of $199, and is available from Dick Smith Electronics and Toys R Us stores around Australia.

grammed via the IR link in a few seconds, and the host robot then set free to demonstrate the freshly downloaded program. Programming the brick really is as simple as that. All it takes is a couple of mouse clicks to instigate the event, since there's no programming cables to connect, mode controls to operate, or jumpers to change over.

If you're really serious about programming though, the restrictions of the kid-friendly code setup soon come into play. With more complex programs the screen soon fills up with code blocks so that only a section of your program is shown in the window. The screen (fixed at 640 x 480 pixels) autopans to bring in sections that were out of the window, but this comes quite difficult to deal with as the code size increases. The potential of the RCX brick hasn't escaped Lego robot enthusiasts around the globe however, as work is apparently underway to develop RCX programming environments in standard high-level languages — these are sure to appear on the Internet as advances are made.



The sensors connect to the RCX brick via clever setup based on standard Lego blocks - note the metal contacts on the block 'nubs'.

Hands-on learning

I guess it's pretty obvious that I loved the Robot Invention kit, as did my offspring. The next battle will be packing up the system to send back to Mr Lego — there's a certain little boy that's going to take issue with *that* activity.

The Lego MindStorms series of kits demonstrate just how well this type of hands-on learning can work when implemented with intelligence, fun and wit. Kids of all ages can make rewarding autonomous robots while learning about computer science, mechanical engineering, teamwork and problem solving without even realising it's happening. Considering the way the world's heading, the educational value of the kit is huge. I can see schools of the future having one for every class, bolstered by access to shared Lego Mindstorms resources on the Internet.

The Robot Invention kit has a recommended retail price of $429, which puts it at the upper end of what parents may be willing to pay for what appears to be a toy. The quality and educational value of the system changes all that, in my opinion. When you witness kids having a terrific time while they naturally manipulate components in both the physical and digital sense, it starts to look like a wise investment.

My problem is that I'll have to save up for *two* Robotics Invention kits to avoid squabbling over components with Max. Hmm, two kits... Now, the RCX bricks can apparently talk to each other... So, if I set up a data link between the two, and then....❖

Lego's MindStorms Robot Development kit

Good points: Well designed, very educational, and great fun.
Bad points: Programming capability is limited. It's not cheap.
RRP: $429
Available: Dick Smith Electronics and Toys R Us stores.

Philips CDR-765
Audio CD Recorder

How would you like to be able to record your own audio compact discs, without having to buy a Pentium-type PC complete with high-capacity hard disk, a 'CD burner' drive and the appropriate software — as well as learning how to drive it all? That's what the Philips CDR-765 is designed for, and it does the job well; but there are a few little catches...

by Jim Rowe

IT'S TRUE THAT a PC-based setup for recording compact discs does seem like overkill, if you're really only interested in making your own audio discs. The idea of having a self-contained and easy to drive audio CD recorder — much like familiar audio cassette decks, or the newer MiniDisc recorders — sounds a lot more appealing.

So the intended market for the Philips CDR-765 is pretty clear: people who only want to make their own *audio* CDs, with less hassle and at lower cost than using a full-scale computer system with CD recording paraphernalia. As you can see from the photo, it is indeed a self-contained audio 'component', virtually identical in size (435 x 305 x 88mm) and weight (4kg) to a standard CD or DVD component player.

The main clues that it's more than just a CD player are the presence of *two* disc trays rather than one, and (when you look closer) a number of extra control buttons on the front panel, with labels like 'Record', 'Finalise', 'Rec Level', 'Erase' and 'Dubb'. Similarly on the back there are quite a few additional connectors, marked 'Analog In', 'Digital In', 'Optical In' and so on. The fluorescent display also has rather more legends than on a normal CD player.

As you might perhaps guess from those dual disc trays, the CDR-765 is in fact a CD player as well as a recorder. Counter-intuitively, though (at least for we right-handers), the right-hand tray is that for the player section, while the one on the left is for the recorder.

Does having the built-in player deck mean that the CDR-765 can be used for dubbing — making a copy of an existing CD? Yes, indeed it can, and quite easily. In fact it can make either digital or analog copies, either of a full disc or just a selected track, and at either normal or twice speed. There are certain limitations to disc copying, though, as I'll explain shortly.

But here's the first little catch: the CDR-765 can't actually use the low cost CD-R and CD-RW blanks sold for use in computer-type CD burners...

By the way, just as most PC-based CD burner drives can also function as a CD reader/player, by throttling back the laser power to 'read' level, so the recording side of the CDR-765 can also act as a player. This means that as well as being able to record and copy CDs, it can also be used as a double CD player. The two decks can even be playing two different discs simultaneously, in 'Dual' mode, with completely separate outputs. Alternatively you can have both outputs commoned, and use them to achieve contiguous playing — cueing up the next disc on one while the other is playing.

So what kind of recordable CD blanks can the CDR-765 record on? Ah, I thought you'd never ask. Well, it can record on both CD-R (write once) discs and CD-RW (erasable/rewriteable) discs, the same two basic types used in the computer field.

But here's the first little catch: the CDR-765 can't actually use the low cost CD-R and CD-RW blanks sold for use in computer-type CD burners. It's designed to record only on the special 'Digital Audio' versions of these media, which cost significantly more (see box). If you try to record on a computer-type CD-R or CD-RW blank, it'll simply display an error message ('NO AUDIO') and refuse to proceed.

Another complication arises from the fact

that like most consumer-level digital audio recording equipment, including MiniDisc recorders, the CDR-765 embodies the Serial Copy Management System (SCMS). So it can make a digital copy of a digital original, but no further digital copies of that copy. You can of course make an 'analog' copy at any time, and although this is theoretically less 'perfect' than a digital copy, the differences are generally very hard to detect.

In the case of the CDR-765 the built-in DUBB function seems to look after the decision making automatically, when it comes to disc copying. If the source disc is a digital original, and unprotected, it will make a direct digital copy via the bitstream; otherwise it will either refuse to make a copy (if the recording is 'copy prohibited') or pass the signal through D-A and A-D conversion, to make an 'analog' copy. As analog recording can only be done at normal speed, this means that twice-speed copying can only be done from unprotected digital originals.

One handy facility of the CDR-765 is a four-level analog recording level control, adjusted via a pair of control buttons under the centre display. Used in conjunction with the 'bar graph' stereo level display, this gives you a better chance of optimising the recording level when you're recording from analog sources like microphones, a record player or tape recorder (via a suitable preamp or mixing desk, in each case). The control steps available are -3dB, 0dB, +3dB and +6dB, with 0dB corresponding to an input sensitivity of 500mV RMS.

Another nice feature, and one that makes the CDR-765 easier to use when you're recording multiple tracks, is automatic track numbering. If you simply 'pause' the recorder after making each 'cut', it will automatically increment the track number ready for recording the next one.

By selecting the 'CD Sync' feature, it's also possible to automatically make synchronised digital copies from an external digital source, such as a DAT or MiniDisc player (or CD player) with an electrical or optical bitstream output. This means that the recording will begin automatically on the arrival of the music bitstream, and track numbering will again be automatic for multiple tracks.

Despite what you might expect, the drawer on the left is for the recorder and that on the right for the player.

As the CDR-765 has no sample rate conversion circuitry, it will only accept 16-bit 'linear' PCM bitstream input, at the standard CD rate of 44.1kSa/s. So you generally won't be able to make digital recordings from DAT recordings made at other rates, 24-bit 96kSa/s 'super hifi' CDs or DVD sound tracks. Possibly not HDCD discs, either, I suspect.

The actual process of recording a CD with the CDR-765 is quite straightforward, and much the same with either a CD-R or CD-RW disc. First you provide the blank disc; when you close the tray, the recorder checks it for acceptability and performs its 'OPC' calibration to determine the correct laser power for recording it optimally.

After this you can proceed to make your recording, either all at once (up to 74 minutes' worth) or track by track. Then, when you're finished recording that disc (or that session, if you're using a CD-RW), you simply 'finalise' it by pressing the Finalise button followed (within three seconds) by the Record button.

Finalising is necessary before the recordings can be played on a standard CD player, because it's only then that the recorder creates the disc's 'table of contents' (TOC) by copying from the temporary 'program memory area' (PMA) where the track information is stored while the disc is 'open' for recording. The process typically takes a bit over two minutes, and until it's done the disc won't play on any CD player (because they can't read the PMA).

Conversely, once a disc *is* finalised, you

'Digital Audio' CD-R and CD-RW discs

Self-contained 'consumer' CD audio recorders like the Philips CDR-765 will not record on low cost CD-R or CD-RW blank discs of the type widely sold for use in computers. They only accept special versions of these discs, identified by a logo featuring the words 'Digital Audio'.

The reason for this is that when relatively low cost CD recorders like the CDR-765 became practicable, the music industry was worried that they would encourage widespread copying of their copyright recordings. One of the protection schemes they insisted on, before they agreed to the release of such recorders, was that these products should only be permitted to use 'special' blank discs — whose price would include a levy, to be paid to the music producers.

In effect, the assumption is that all recordings made on consumer CD recorders will be duplicates of copyright material; so users are forced to pay a tax or royalty fee 'up front' as part of buying the blank discs. Tough luck if you're recording your own original music!

The actual media used in Digital Audio CD-R and CD-RW blank discs are basically the same as for computer discs, except that there's a built-in 'secret code' so the recorders can identify them. There's very little information on exactly how this coding is implemented, but the Digital Audio discs apparently use a different 'wobble' frequency for the tiny pre-pressed groove which guides the recording laser across the disc, in a spiral with a standard track pitch of 1.6um. The recorder can identify discs with the 'allowed' wobble frequency from the error signal in its laser tracking servo... This restriction only applies to 'consumer' CD recorders, incidentally. Professional audio CD recorders will happily record on computer-type blanks, as of course do computer based CD burner drives. So if you wish to record your own original music on CD, without paying a hidden levy to the commercial music industry, you can do it via a PC-based setup or a professional audio CD recorder.

can't record any further audio on it. This means that once a CD-R is finalised, that's it; the disc has effectively become a normal read-only CD.

Happily with CD-RW discs, it's not that final. After listening to or otherwise making use of the recording, you can either erase the complete recording, ready to record the disc again, or simply erase the TOC ('unfinalise' the recording) to allow the recording of additional tracks. With the CDR-765 it's easy to do either, simply by pressing the Erase button once (for erase) or twice (for 'unfinalising'), followed by the Record button.

Rated (digital) frequency response of the CDR-765 is 0 - 22.05kHz, with a playback signal-to-noise ratio and dynamic range of 100dB and 95dB respectively. The corresponding figures for analog recording are 90dB and 92dB, respectively. The THD (total harmonic distortion) for both recording and playback is rated at 0.0056% (-85dB).

What we found

Philips Electronics kindly made available an evaluation sample of the CDR-765, together with a couple of CD-R blanks and a CD-RW blank to try out its operation. This allowed us to put the unit through most of its paces, and get a good idea of its capabilities.

Measured in replay mode, both of the sample CDR-765's decks turned out to have a smooth and extended frequency response from 20Hz to 20kHz, within +0dB/-0.4dB. They were not all that outstanding in terms of S/N ratio or replay linearity, though — with the 'replay' deck actually a little poorer than the 'record' deck, in both respects. We could only get S/N figures of about 70dB for the former compared with about 86dB for the latter, and the replay level began tapering off into noise just below the -60dB level compared with just above the -80dB level. So for the best S/N performance and linearity on replay you'd want to use the 'record' deck, strange though it seems.

The impulse and square wave response of both decks was virtually identical, displaying about 10 - 11% (pk-pk) of the usual symmetrical ringing. This is again best described as 'good' or 'above average' rather than excellent, especially when compared with the best modern CD or DVD players.

On the other hand when we tried a complete analog record-play run using the CD-RW evaluation disc, the results were quite impressive. The level response of both channels was very well balanced (within 0.1dB), and their overall frequency response was very smooth: flat within about +/-0.1dB over most of the range, and only 0.2dB down at 2Hz and 20kHz.

All of this performance is a considerable improvement over the recording quality that you could achieve with traditional analog audio recorders, of course.

Just for the record we also tried making a digital copy of an existing CD, both to check the 'twice speed' facility and also to confirm that there's no audible degradation. The original had a recording time of 69.35 minutes, and we timed the copying at 36 minutes plus a further 2 minutes for finalising. This gave an effective 'speedup' of just over 1.8 times.

Certainly we couldn't detect any audible differences between the copy and the original recording, either. Not that there should be any, with this kind of direct bit-for-bit copying.

Overall then, we found the Philips CDR-765 CD Recorder/Player a very good (though not outstanding) performer. Considering its performance and ease of use, it seems quite reasonable value for money at the quoted RRP of $1099. For anyone wanting to be able to record their own audio CDs without hassle, and without the need for a full-scale computer setup, it's certainly well worth considering.

By the way the prices of the special Digital Audio CD-R and CD-RW discs do seem to have fallen, making them less expensive than they were compared to 'no royalty' computer media. We were quoted $5.95 each for the CD-R discs, only about double that of computer CD-Rs, and $29.95 each for the CD-RWs.

So although you'll still be paying a levy to the music industry even when you're recording your own music with the CDR-765, it's not going to be too drastic. ❖

Philips CDR-765 Audio CD Recorder

A self-contained dual tray unit which can function as a 'consumer level' audio CD recorder, twin CD recorder, or digital/analog copier.

Good Points: Able to make audio CD recordings and copies with a minimum of hassle; digital copies are essentially 'perfect' copies, too. Has direct electrical and optical digital inputs, for flexibility.

Weak Points: Limited by SCMS and the need to use 'Digital Audio' CD-R and CD-RW blank discs; the replay S/N ratio and linearity is also only 'above average' by modern standards.

RRP: $1099.

Available: Philips AV dealers.

Serial Copy Management System (SCMS)

Consumer-level digital audio recording equipment such as CD and MiniDisc recorders incorporate the Serial Copy Management System, which is another requirement insisted on by the music recording industry. SCMS is designed to allow making a digital copy of designated digital original recordings, but no further digital copies of that copy. Clearly it's again designed to prevent widespread of copyrighted music recordings.

SCMS apparently works by recording a code along with the music, to indicate whether it is 'protected' or not, and also whether the recording concerned is an original or a copy. There may also be a Recorder Unique Identifier (RUI) code, to allow tracing the machine on which the recording was made.

Consumer-level recorders are designed to detect the code in any incoming digital bitstream, and only allow digital recording if it is either an unprotected or original recording. If the code reveals that the bitstream is coming from a digitally recorded copy, the recorder will refuse to record it again.

Note that SCMS doesn't prevent you from making one digital 'clone' of an existing CD or MD recording. You can even make multiple digital copies, providing they're all made separately from the same original (which requires either a lot of time and patience, or investment in multiple recorders).

In any case, SCMS only effects direct digital copying; it doesn't control copying made by 'analog' dubbing — converting the original digital recording to analog by passing it through a D-A converter (which 'loses' the SCMS code), and then reconverting it back to digital for recording. However this double conversion process inevitably produces some degradation of the recording quality, in terms of increased distortion and poorer signal-to-noise ratio, compared with direct digital copying.

Note that again, SCMS is only imposed on 'consumer' digital audio recorders. Professional digital recorders and computer-type recorders generally seem to ignore the SCMS code.

MicroGram Computers

VGA to Video Converter

High quality at an affordable price, this totally external unit does not require software drivers, hence, no software clashes. It supports up to 32 bit colour at resolution 1152 x 864 with a refresh rate of 130 Hz.

Cat. 3102 **VGA to Video Converter** $479

Windows Terminal

This windows based terminal is suitable for both NT Terminal Server & Citrix Metaframe as well as being configurable for Unix hosts. It supports Microsoft's RDP and Citrix ICA3 protocols. In addition, it also emulates a number of standard terminals. Ports provided include a DB25 parallel port, two DB9 serial ports, two USB ports, VGA DB 15, PS/2 mouse & keyboard ports & audio in & out. It is used in conjunction with a standard monitor, keyboard & mouse.

Cat. 1214 **Windows Terminal** $1299

Serial and TCP/IP Ethernet LAN terminals.

Cat. 1026 **Serial Terminal 115.2Kbps** $469
Cat. 1133 **Serial Terminal 460Kbps** $489
Cat. 1104 **TCP/IP Ethernet LAN Terminal** $499
Cat. 1134 **TCP/IP Ethernet LAN Terminal with LPD** $519

Hot-Swap IDE RAID Array

Avoid downtime delays when your hard drive fails! This unit enables the user to replace the hard disk while the PC is operating and it automatically resynchronizes itself to full operation. The RAID unit fits into two continuous 5.25" bays and includes a controller and two removable frames. The array accepts two EIDE, Ultra DMA 66/33 or PIO 4 hard drives. The controller provides RAID Level 1 disk mirroring. It can also be used as an on-line hard drive copier.

Cat. 2808 **HDD Hot Swap IDE RAID Disk Array** $1299

VGA Monitor Splitters

Splitter modules enable up to 8 monitors to simultaneousy share the information of a host computer. The ideal way of providing multiple displays in training rooms, airports, stock rooms, clubs, etc.

Cat. 3070 **Two Output** $269
Cat. 3055 **Four Output** $336
Cat. 3056 **Eight Output** $574

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Two products to keep your computer and your hard drive cool! Dissipate heat with dual exhaust fans attached to a plenum to exhaust hot air from inside the computer. Reduce the possibility of data loss due to your HD overheating with dual fans attached to a ventillated face plate. It will effectively dissipate heat from the HDD & significantly lower internal temperatures.

Cat. 8564 **Hard Drive Cooling Fans** $49
Cat. 8420 **Dual Exhaust Fans** $45

Mobile Racks

Removable storage modules are the perfect solution for protecting your valuable data. Features include an easy pull-out handle, auto-close door design, LED indicators for power & hard disk drive as well as an internal cooling fan. Also available is a IDE hot-swap model.

Cat. 6610 **Mobile Rack HDD Frame Kit IDE** $69
Cat. 6611 **Mobile Rack Tray Only for IDE** $39
Cat. 6614 **Mobile Rack HDD Frame Kit IDE Hot Swap** $159
Cat. 6615 **Mobile Rack HDD Frame Kit IDE UATA 66** $89
Cat. 6612 **Mobile Rack HDD Frame Kit SCSI** $79
Cat. 6613 **Mobile Rack HDD Frame Kit SCSI Wide** $129

Parallel Port EPROM Programmer

An EPROM programmer that connects to LPT 1, 2 or 3 and has a 32 pin ZIF socket. It will program 16K to 8M bit EPROMs without adapters. Fully featured software accepts Binary-Intel/Extended Intel-Motorola S19/S28/S37 & Tektronics Hex formats. Optional adapters available.

Cat. No. 3159 **Parallel Port EPROM Programmer** $399

Year 2000 BIOS Card

I'ts not too late!! All you have to do is plug it in! This card has it's own RTC & carries the NSTL "Compatibility Test" seal.

Cat. 3359 **Year 2000 BIOS Card** $129

SmartMedia Reader/Writer

A SmartMedia (as used with digital cameras) reader/writer which connects to the parallel port to allow fast transfer of your photos to your computer. The reader appears as another drive on your PC, just use Windows Explorer to copy the files.

Cat. 6603 **SmartMedia Reader/Writer** $279

Fast Ethernet Media Converters

Convert from Fibre to MII (Media Independent Interface) or 100Base-TX. Available with SC or ST fibre connectors.

Cat. 11327 **Ethernet MII to 100Mbps Fibre SC** $349
Cat. 11328 **Ethernet MII to 100Mbps Fibre ST** $349
Cat. 11325 **Ethernet 100Base-TX to Fibre SC** $359
Cat. 11326 **Ethernet 100Base-TX to Fibre ST** $359

Printer Servers

There's no need for a computer just to operate as a printer server, or you can avoid slowing down a work station when a print job is running by installing this small print server. It connects directly to the printer and a UTP cable. Suitable for Windows 95, Windows NT, Novell, TCP/IP and Unix.

Cat. 11288 **Printer Server 1 Parallel Port 10MB/s** $209

Also available, auto-sensing dual speed 10/100MB/s print servers.

Cat. 11312 **Printer Server 1 Parallel Port 10/100MB/s** $289
Cat. 11293 **Printer Server 3 Parallel Port 10/100 MB/s** $399

PS/2 Multi-PC Controller 2 Way

This sophisticated controller allows one keyboard, monitor and mouse to control two PC's. Keyboard, monitor (DDC2), and mouse emulators allow boot up of all computers regardless of switch position.

Cat. 11613 **PS/2 Multi-PC Controller 2 Way** $319

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Finding your way without delay:
GPS exposed!

by Tom Moffat

Things have come a long way since Captain Cook's day:
"What the #@%! is that!?"
"I dunno mate,
I don't think we've seen it before."
"Well let's call it Australia then..."
(Or something like that, anyway).

NOWADAYS WE NOT ONLY KNOW the boat's in Australia, but we know it's in Sydney Harbour, in a marina, in the sixth berth from the entrance, and the boat's about a metre from the end of the berth and travelling at ten centimetres a second — all thanks to GPS, the Global Positioning System. This is not imagination. I once saw a demonstration on television of a GPS receiver connected to a boat's autopilot. The boat was berthing itself automatically, guided by satellite signals, as the skipper stood there with his arms folded, smiling with satisfaction.

This was GPS taken to its ultimate. The system available to you and me is downgraded somewhat for military reasons, but it's still very good and on a decent day it can nail down your position anywhere on the earth or in the sky, to an accuracy of fifteen meters or so. Extremely accurate GPS surveying equipment is claimed to fix a position to with-

in a centimetre, the width of a fingernail.

In this article we're going to take a close look at the workings of this GPS magic, and next month we'll use a handheld GPS in the real world to plot and navigate trips by car, bicycle, and foot.

GPS explained

Most of us have heard of the GPS navigating system, but it never really sinks in until you hold a tiny satellite receiver the size of a TV-remote in your hand, and it tells you were you are, with uncanny precision. This comes about with the aid of up to twelve orbiting satellites, all received and decoded at once.

GPS receivers come in many shapes and sizes. There are high-precision mapping devices the size of a suitcase, and shipboard receivers the size of a shoebox or smaller. There are GPS receivers for cars, which display a moving street directory showing where you are. The latest rage is handheld GPS units of the TV-remote style, and on the horizon, according to a Mt. Everest climber I spoke with, is a GPS receiver the size of a wristwatch.

Handheld GPS receivers have a graphics display, about the size of a playing card, which is organized as a series of screens or pages, showing:

- a screen with all GPS satellites in view at the time, as calculated from a stored 'almanac'. There are also multiple S-meters showing the signal strength from each satellite, and possibly a battery-level meter.
- a position page showing your current longitude and latitude, your altitude, your current speed and time travelled, the current time accurate to better than WWV standards, and various other numeric data.
- a moving graphic map showing where you are in relation to various landmarks. If you are travelling a pre-planned route, that route is displayed too, and you can track your movement along it. The map can zoom in and out and pan around.
- a navigation page dominated by a large arrow which points you toward your destination. A compass rose surrounds the arrow, and there are numeric readouts of your present track and speed, bearing and distance to your destination, and possibly a calculated estimated time of arrival. There is also a menu page for setting up the multitude of functions in the GPS.

While viewing a handheld unit's position page, you can take a couple of steps forward and the longitude and latitude readouts change microscopically. Step sideways and they change again. Start walking and they change constantly as the tiny microprocessor in your hand furiously crunches numbers fed to it from a group of satellites orbiting nearly 18,000km above the earth.

Where's the satellite dish? It's a 'patch antenna' the size of a postage stamp, hidden inside the TV-remote thing. I thought I'd seen everything there was to see in electronics until this GPS came along. It just about blew me away.

The purpose of a GPS receiver is to tell you where you are, and then lead you to where you want to be. It can keep a record of your travels, displaying your movement as a map on the graphics screen. Later it can report exactly where you've been, how long it took to get there, how fast you were going, and the locations of any particularly interesting things you've found along the way.

Everything the GPS has learned during its travels can be loaded into a computer and displayed on a map of your area. Illustrated here is a map of the town I live in, Port Townsend. The yellow tracks are those I've made on foot (note the beach walking), purple lines are from bicycle rides, and blue tracks were made in the car. We'll look at computerized GPS more closely next month.

Go west, young man

The GPS satellites are there for one main purpose: to accurately fix your position in three dimensions — latitude, longitude, and altitude. And it's very important to note that a new fix is being calculated about once a second. Unlike a compass, the GPS cannot tell you which way you're facing. It can only tell you which direction you are TRAVELLING. If you stand in one place and spin around with your GPS receiver, nothing will happen. You are getting continuous position fixes but the are all landing in the one place.

If you start moving west, the next position fix will be a little west of the previous fix. And the next one again will be further west. After a series of westerly changes, your GPS decides you must be moving west, and it swings its compass display to point west. It also knows how much distance passed between each fix, so it displays your speed.

Talk to your GPS!

To help understand how the GPS works, there is a computer program called G7TO that will let you connect your computer to a GPS (Garmin or Lowrance models) and then directly download its stored routes, waypoints, or track logs. You can also access things like the battery voltage readout or the almanac the GPS uses to find the satellites. Anything downloaded can be uploaded back to the GPS again, perhaps after some editing. All the data is in human-readable text format, and once you study it you'll understand a lot better how GPS operates.

The version of G7TO I use is a pure MS-DOS program, not overly large (186k), and it contains full instructions in a Microsoft Word file. You'll need them because G7TO uses the most convoluted command-line syntax I've seen in a long time. Look for G7TO.ZIP in the EA web site's download area.

It's this way! — the compass screen points the way to Mt. Townsend.

It's essential to remember with GPS that all navigation data other than position are determined by movement of the receiver. The display assumes that the body of the receiver is pointed in the direction of travel. If you point it north, but shuffle along sideways in a westerly direction, the GPS will still claim you're pointed, and heading, west.

The GPS continuously collects satellite data and uses it to build on what it already knows. When you first power-up a GPS receiver it takes perhaps a minute to lock onto satellites which have moved during the time it's been turned off. Once lock is achieved, the GPS will announce success by displaying your current latitude, longitude, and altitude, and then you can begin your trip.

If you begin moving east, it may be 30 seconds before the compass indicator moves to indicate east. It may swing around a bit, becoming more steady as you move along. The further you go, the better it gets, as the GPS uses more and more satellite fixes to refine what it already knows. Pretty soon you're cruisin' along, the direction indicator is pointing the right way, your speed is accurately displayed, and the distance counter is clicking over. That is, until you walk under some trees...

GPS is not perfect. Each of those satellites, so far away, is kicking out about 50 watts, and you're trying to receive them on an antenna the size of a postage stamp. This link is somewhat, er, fragile... and a few trees can block the path to some satellites — and accuracy suffers. Same goes for tall buildings, and power lines, and even the shadow of your own body. One doesn't bet one's life on GPS. It's a great helper, but smart people carry a compass and map with

them, just in case.

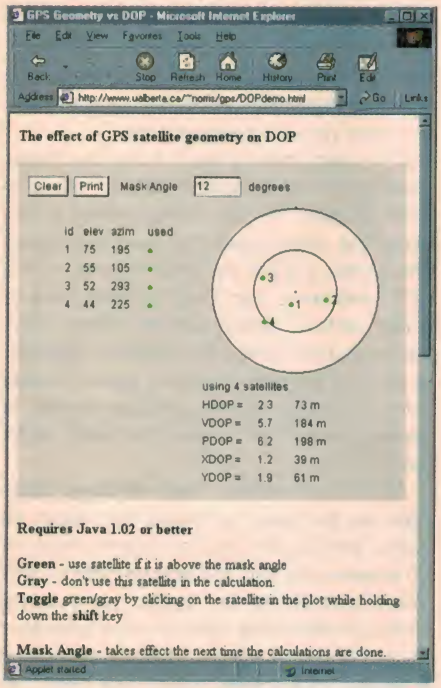
The GPS satellites are owned, and controlled, by the United States Government, primarily for military navigation purposes. They're only being kind letting civilians use GPS too, and even then they degrade the signals somewhat so we can't get full accuracy. This is known as SA, or Selective Availability, and it's done so some terrorist can't plant a GPS receiver into a cruise missile and track it to a vital defense installation. SA will throw the missile off course, so it will kill civilians instead.

With the Cold War over, the civilian GPS industry is leaning on President Clinton to make the military stop using SA, so civilians can have access to the full accuracy of the GPS system. But, in times of political tension, the military could instead make SA worse, or even switch off the GPS system altogether. So carry a compass!

Techie stuff

GPS operates on a "more is merrier" system; hence, at any one time there are 24 satellites, four each in six orbital planes, feeding navigation data to anyone who will listen. The orbits are arranged so that anywhere on Earth, at least seven satellites will be visible at any given time. Modern receivers can handle a maximum of twelve satellites at once.

Each satellite sends out information allowing calculation of where it is in space at any instant. How does it know where it is? Its position is measured by a very accurate radar on the ground. The orbital information is cooked up into an 'almanac' that is relayed back up to the satellite, from where it is broadcast to any GPS receiver in range. The receiver collects an almanac entry for each satellite, which it can use to find that satellite's orbital position any time it is in view.



This is a natty little Java applet that will let you position satellites and see their effect on the system's accuracy.

Each of the satellites carries its own atomic clock, and it relays very accurate timing information to every GPS receiver in view. This means each receiver knows what time it is within a few nanoseconds, and most of them display the time somewhere on the readout. So you can hold in your hand a clock which is many times more accurate than anything previously available to the consumer, or the scientist for that matter. GPS signals are now the time standard of choice, superseding the time and frequency radio stations such as WWV. With accurate time on board, it's a simple matter for a GPS receiver to figure out how far it is from a satellite by measuring the time it takes a radio signal to get from the satellite to the receiver.

The 'how far' factor is the key to GPS navigation. Assume for a moment there is only one GPS satellite, and you have determined by timing measurements that you are 19,000km from it. In fact there could be many objects 19,000km from that satellite, but every one of them would lie on the surface of an imaginary sphere with a radius of 19,000km.

Now let's add a second satellite, and you're 20,000km from that one. So you're somewhere on a second sphere, 20,000km in radius. Let's also assume the spheres are not solid, so one of them can be inside the other's space. When that happens, all points where the SURFACES of the spheres meet, describe a CIRCLE. Can you visualize that?

Now let's add a third satellite, and you are 21,000km from that one. The surfaces of all three spheres meet at only TWO POINTS. One point is your location, your current position fix. The other point is a ridiculous answer compared to your last fix, so it can be discarded. You now know your *latitude* and *longitude*, courtesy of three GPS satellites. This is called a 2-D fix. Throw in a fourth satellite and you can calculate your altitude, for a 3-D fix.

These are the bare minimum satellites needed for a 2-D or 3-D fix. If more satellites are visible, then the GPS uses them too to further refine your position, up to a maximum of twelve satellites at once. Accuracy is also affected by the geometry of satellites visible. If they are all in a line, or all clumped together, accuracy is terrible. It's best when they are evenly distributed around the sky.

Move your own satellites

The University of Alberta in Canada has an excellent online demonstration of how the

Logs and waypoints

The GPS receiver is a very sophisticated piece of equipment, but from a user's point of view, it has only one major task: working out your position — left/right, forward/backward, up/down. The position can be expressed as latitude/longitude, UTM (a grid-reference system), and several other formats used by different countries. The first two dimensions are used for navigation; the altitude is more for information, to make you feel proud of how many metres you've climbed to get to the top of a mountain. GPS altitude isn't all that accurate; you'd never rely on it in an aircraft, but it's still useful.

Positions calculated by the GPS receiver can be stored away in a 'track log'. You can string together many positions over time, display them on a map, and see where you've been. You can also feed positions *into* a GPS from its keypad or a computer. These can be named or numbered and then stored in the GPS receiver's memory. Later you can select a stored position (where you want to go), and compare it with your present position (where you are now), and the GPS will display an arrow showing you which way to go to get there. This is the fundamental basis for all GPS activity, and it's referred to as the GOTO function.

There is a little confusion in terminology here. Your collection of stored positions (up to 500 of them in the Garmin 12XL) is referred to as a list of 'waypoints'. But they are really waypoints only if they are on the way to somewhere else, as in a 'route' (explained shortly). I prefer to think of unattached waypoints as 'markers'. Markers are used to remember some point of interest, either as a landmark or somewhere to return to later. They can come from two sources: a computer, or directly from the GPS keypad. I have placed GPS-based markers on mountain peaks in our area so they can be identified by sight. If, while tramping along some high ridge, I want to identify Mt. Constance, I command the GPS to do a GOTO function with Mt. Constance as the target. The compass arrow on the display then swings around and points toward Mt. Constance.

Here's a map of Port Townsend — The yellow tracks are those I've made on foot, purple lines are bicycle rides, and the blue routes were made in the car.

You can also record your actual position as a marker, and the Garmin has a 'mark' button just for this purpose. It generates a new entry in its waypoint list and invites you to name it. This is a good idea just before you leave the track to begin scrambling to the top of a mountain, so you can find your way back in case of fog or darkness. I've also used the mark button to record local landmarks such as the local hospital that is high on a hill and visible from everywhere. It makes a good position reference.

A route is simply a series of markers, now known as waypoints, strung together to lead you where you want to go. They are just like stone cairns on high mountain routes — you walk from one to the next and the next until you are at your destination. In the GPS, as you pass each waypoint, the GOTO arrow swings toward the next waypoint, and you just follow the arrow.

You can compose a route in the computer, planting waypoints along a walking track on a map, and each waypoint is then joined to the next with a straight line. The lines are known as 'legs'. A completed route can then be uploaded into the GPS where it appears on its own map display — all the waypoints and the legs that join them.

number of satellites and their positions affect the accuracy of a GPS fix, expressed in metres error and DOP (Dilution of Position). The display shows a sky view containing the GPS satellites, exactly like the satellite view screen on a GPS receiver. Except in this case, you can grab the satellites with your mouse and shove them around, watching the amount of error change in real time.

You can also add or subtract satellites to see how this affects accuracy. The program is a Java applet that runs directly from the web page, which is at **http://www.ualberta.ca/~norris/gps/DOPdemo.html**. In this case, a picture is definitely worth a thousand words.

An extension to regular GPS called DGPS uses a low-frequency receiver to receive correction signals and add them into the position calculation. This improves accuracy to around a metre under ideal conditions, but the low-frequency signals are easily degraded by noise or fading. Sometimes DGPS correction information is transmitted by FM broadcast stations as a subcarrier, providing much enhanced signal quality. In this case one is usually obliged to pay for the service.

The GPS satellites transmit on two frequencies: 1575.42 and 1227.6 MHz. Only the higher frequency is used for civilian receivers; both are used by the military. The signals from the satellites are basically pseudo-random noise ranging codes. There is a coarse code with a 1.023MHz clock rate and a repeat rate of one millisecond. A separate precision code has a 10.23MHz clock rate (ten times as fast as the coarse code) and a repeat rate of seven days. The coarse code is used primarily to acquire the precision code, which then becomes the primary navigation ranging code.

The ranging signals must also carry satellite system status data, and the almanacs. These are modulated at 50 baud, the same speed as the old mechanical teletype machines. It's no wonder there's a considerable wait while a GPS receiver gets its act together at power-on.

The pseudo-random nature of the satellite signals means some very sophisticated techniques can be used to extract them from the noise. The receiver is able to lock onto the pseudo-random pattern and then determine where it is in time, and thus distance, from the transmitting satellite.

An obvious question is how is it possible for 24 satellites to all transmit at once without interfering with each other? I have been unable to find a direct answer, but it seems that the given the frequency accuracy, the signals would all be in phase, instead of fighting each other. Some broadcast stations operate this way, so it should apply to GPS as well. GPS technical literature also refers to the transmission system as 'spread spectrum', allowing an excellent margin against interference. Whoo! This is getting too heavy...

Bumblebee antennas.

Lastly, I'd like to talk briefly about patch antennas. These seem to closely follow the bumblebee theory, which states that because of its weight to wing area ratio, a bumblebee can't fly. But it does fly. Similarly, the patch antenna is so tiny it can't possibly work. But it does work very well. In my Garmin GPS receiver, the antenna is totally enclosed within the receiver's case.

The patch antenna is basically a small rectangle of conductor, such as copper, mounted on a substrate, which is in turn mounted on another larger rectangle of copper. What we're really talking about here is a chunk of double-sided circuit board. The whole works is a small fraction of a wavelength across.

To go into the theory of patch antennas would require another complete article, so we'll give it a miss for now. But if you search for 'patch antenna' on the Internet, you'll find all kinds of stuff including suggestions about how you can build one from circuit board.

The patch antenna has a cardioid-shaped radiation pattern pointing straight up, and most are circularly polarized. It sounds like a scaled-up version would make a good antenna for weather satellite reception — maybe that's worth a try some day...

Next month we will look at the practical applications of GPS, on foot, bicycle, and car. Unfortunately water misses out since I'm boatless right now. But there should be plenty to get you wandering around the bush, staring at the TV remote in your hand. So people will think you're nuts — who cares! You can laugh back at them when they are 'geographically embarrassed' and you're striding firmly toward home! ❖

Earthquake

Many people use the Net to keep up with the latest events around the world. But the Net can still be your best source of information even if those events are happening under your very feet, as Peter Marks found when the Taiwan earthquake recently hit.

by Peter Marks. BOCP, VK2TPM.

At 1:47am on Tuesday, September 21st, I awoke suddenly along with probably all of the other 22 million people in Taiwan. It was pitch dark as the power was off and the only sound was the coat hangers banging against the wall and cupboard door of my hotel room. My first thought was that someone was shaking me awake, but I soon figured out that it was an earthquake.

The motion was large but smooth and cycled between sideways, front and back and some up and down swings. It seemed to go for about a minute, which was enough time to vividly recall the news footage of the recent devastation in Turkey. I do admit that I got dressed with thoughts of wanting to look my best when pulled from the rubble.

The hotel I was in (the Lai Lai Sheraton) was built as are all buildings in Taipei in the last 10 years, to survive major earthquakes. The only damage I noticed was grout from the bathroom tiles that had fallen into the bath.

My colleague knocked on the door and said he'd decided to leave the building. As the fancy electronic door locks are disabled when the power is off, I decided to stay in my room. He reported later that the hundreds

of people who spent the night in the street in front of the hotel represented an instant snap-shot of contents of the hotel — including a couple of 'professional' ladies dressed to make the earth move...

Use the net Luke...

Despite the lack of power, the phone still worked. As my laptop was charged, I took the opportunity to connect to the Internet. My company uses AT&T Business Internet services (which used to be IBM.net) to connect to our office email from hundreds of countries around the world. I connected without problem and sent off messages to the family and office along the lines of "Rumours of my death have been greatly exaggerated...".

To their credit, www.cnn.com had the Taiwan quake reported as their lead story just 30 minutes after it had occurred, so I was able to read about the size of the quake and where it was centred. Judging by the garbled information provided by the hotel manager over the PA, I was easily the most well-informed in the building.

A local English FM radio station had a rather panicky announcer asking listeners to call in to report on what had happened. During the morning their staff arrived and each reported what they'd seen on their way in. As an aside, all the FM stations in Taiwan use the 'Radio Data System' so that their call sign is displayed on modern radios — here in Australia only Triple J is smart enough to turn this on (I've seen one station in Perth that had the exciter manufacturers message being broadcast).

Aftershocks

Strong aftershocks continued through the night, one just before dawn measured 6, and over the next few days there were thousands of tremors. As all business and school was cancelled we took the opportunity to go for some long walks around Taipei. Despite the lack of traffic lights, cars moved pretty much as normal. The hotel that did collapse in Taipei was not far away and this was the main focus of news broadcasts. Other than that, the city seemed relatively unscathed except for some fallen masonry and glass.

The epicenter of the quake was in the center of Taiwan and therefore some distance from Taipei and the industrial centers of Kaohsiung and Hsinchu. The more than two thousand people who were killed died because their buildings collapsed. You don't die because of the shaking itself.

Power was cut to virtually the whole island and Tai Power seemed rather pessimistic about restoring it any time soon. A major transforming station had exploded and it was said that even when the generators were repaired it was not a simple matter of just turning them on, as all the major transmission lines would need to be inspected first.

The hotel had its own generator and had more or less restored services during the first day. Industry was reporting that while production lines would need to be checked, the main impact of the quake was due to the extended power outage. A mobile phone carrier we visited told us that they had power in 'rotation' with a number of companies presumably to reduce the overall load.❖

Taiwan earthquake shakes chip prices?

"RAM prices have just tripled", said the technician at a Coffs Harbour computer dealer. "What, even on old SDRAM SIMMs that probably aren't made any more?" I asked. It seemed so — "it's because of the earthquake in Taiwan" he said.

Taiwan is a small island off the east coast of China. In recent decades it has built a worldwide export business and changed the perception of the 'Made in Taiwan' label from a cheap copy to a quality hi-tech product.

12 percent of world semiconductor product is made in Taiwan. While Intel and AMD make their own chips, they also source from Taiwan. Perhaps most significantly, 30 percent of motherboards are assembled in Taiwan.

My favourite shopping center in the world is the Guanghua market on Shin Sheng road in Taipei. Two full floors of tiny shops packed with everything for the electronics, radio and computer enthusiast. Tiny video cameras, MP3 players, portable DVD players (some with goggles), and of course the commodities - CPUs, RAM and CD blanks.

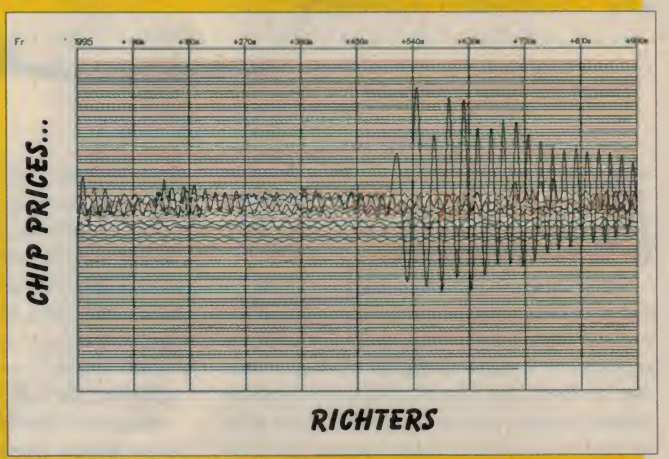
Street prices on semiconductors are roughly half what you'd pay here in Australia, but the really stunning prices are on cables such as those $80 SCSI cables which can be had for about $5.

Products I've only read about, such as AMD K7 Athlon-500 CPUs were on display in dingy shop windows next to noodle vendors. Mysterious tiny transceivers for 'family' use are on display everywhere but no one could tell me their frequency. Ham radio transceiver sizes have now shrunk so much that they are bordering on being unusable.

How can a Coffs Harbour computer shop pass on a RAM price triple within days of a quake in Taiwan? It turns out that computer chips are as much a commodity as wool, wheat or coffee these days. (Coffee is the most traded commodity in the world by value). The spot price for RAM rises and falls on rumour — you might recall that it rose after the Kobe earthquake as well, even though no chips are made there.

Should you stockpile chips as an investment? Well, due to the continuing adherence to Moore's Law — where computers get twice as powerful for the same price every 18 months, no. That's exactly why a large part of the skill of a computer dealer who survives is stock minimization, and why they'll pass on these crazy price spikes at light speed.

Actually, stockpiling wool turned out to be a pretty bad idea as well.



Richter scale

7.6 on the open ended Richter scale is regarded as serious and capable of doing major structural damage. The Richter scale is named after seismologist Charles Richter. Cleverly, the units are proportional to logarithms (base 10) so each unit is a tenfold increase on the last. Not so cleverly, zero on the Richter scale was set at the smallest detectable earthquake in 1935, so now that seismographs are more sensitive they must measure small quakes as negative numbers.

MPIO
MP3 player

Personal MP3 players are certainly starting to catch on. Six months ago they were a rarity, but now you find them popping up all over the place. The Joycom MPIO is the one of the recent ones to hit the Australian market, and like a lot of other modern consumer electronic devices these days, it comes in a translucent blue plastic case...

by Graham Cattley

Apart from its trendy looks, the MPIO (Multi Play Internet AudiO) has a couple of features that set it apart from other MP3 players we've seen.

The most important of these is that is comes with a whopping 64MB internal RAM, and a Flash card slot that will let you upgrade to a total of 96MB of music storage. At the going rate of 1MB per minute for decent quality sound, that adds up to over an hour and a half of music from something that fits in your back pocket.

The hardware

While it looks a little larger than other players we've seen, this is really only an optical illusion. The rather square-cut case gives it a bulky look, but it fits in your pocket just the same.

As has become standard with MP3 players, a four-way rocker button in the middle of the front panel gives you the usual stop/play/rewind/FF, with a couple of extra buttons providing the extra functions. These include audio recording, (up to four hours) and storage for up to 50 phone numbers. Strangely, there's no menu button as such, instead there's a multi-function 'mode select' button that can be a little confusing to deal with.

Displayed prominently on the front panel is an 'erase' button, to instantly erase the selected MP3 or voice file you've selected on the display. Quite why you'd need such quick access to this remains a mystery, and I ended up accidentally erasing a couple of songs after inadvertently pressing the button. This is definitely one function that should have been left to a sub-menu...

A slot in the side accepts a 3.3V 32MB flash memory card, which gives you an extra 30 minutes of playing time, and the PC interface socket has a natty little slide to protect it from the loose change in your pocket.

While current drain runs a little less than other players (which is good to see), there is the drawback that the MPIO draws 1.8mA when switched off. To my mind, this is a mite high, considering that other players get by on a tenth of this. As it only runs on two AAA batteries, you'd be looking at changing the batteries every week or so, whether you use it or not.

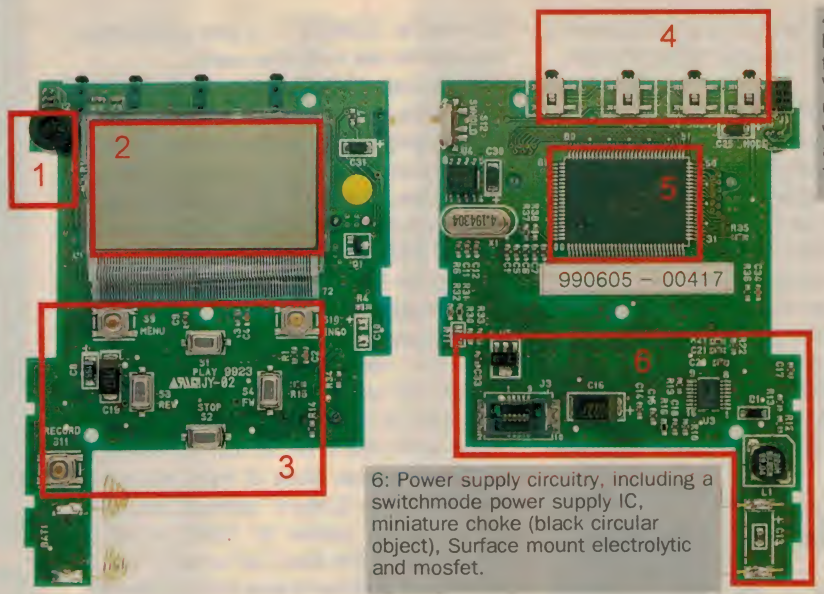
The software

The file manager for the MPIO is simple to install, and simple to use. It's the usual two-window affair, showing a directory on your PC and the contents of either the internal RAM in your MPIO or its extra Flash card, if installed. As well as the manager,

1: Miniature electret microphone for voice recording.

2: Liquid crystal display: can show up to 18 letters x 2 lines, as well as four digits and four Korean characters.

3: Pushbuttons for the various front panel controls, including Mode, Erase, Record, and the four-way Play/Stop/Rewind/FF button.



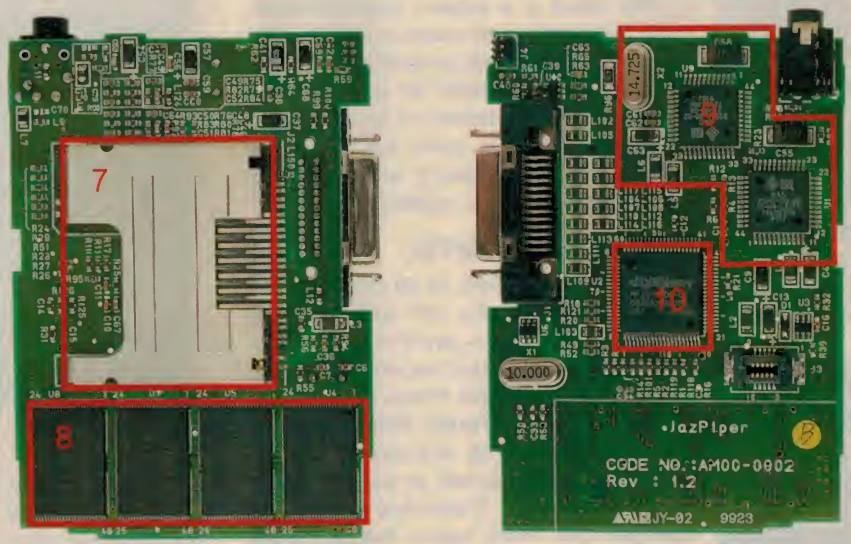
4: Pushbuttons for the Volume up/down, as well as DSP and Repeat functions.

5: LCD driver chip, which handles all the character display functions.

6: Power supply circuitry, including a switchmode power supply IC, miniature choke (black circular object), Surface mount electrolytic and mosfet.

7: Flash Memory card socket. Accepts standard 32MB 3.3V Flash cards.

8: 64MB of Flash RAM. This is where your MP3 files are stored. The songs will be retained in memory even if power is removed.



9: Digital to Analogue converter and DSP chip. These handle the audio side of things, including the volume and DSP settings.

10: The CPU: This is the brains of the outfit, which downloads the MP3 from your PC, stores it in the RAM or Flash card, and decodes it before sending it on to the DSP chips. It also handles the voice recorder encoding as well as monitoring all the pushbuttons.

you get a copy of Jet-Audio 4.5, an integrated multimedia player, supporting most multimedia formats including streaming media, digital audio and video.

It includes sound effects, an audio mixer, a music CD player, digital audio, MIDI (including XM, MID, MOD and S3M support) and even digital video (AVI, QTW, MPG, RM, etc.). It's a comprehensive package, and quite flexible too.

I'd like to get back to the MPIO file manager though - it has a couple of interesting functions that are well worth talking about. The first of these is the file download rate: it's **fast!** MP3s can be downloaded into the MPIO at up to 1.3Mb/s via the PC's parallel printer port. Well, that's what it says in the manual - the reported speed as the transfer is taking place is 420-512Kb/s, which is pretty quick, none the less...

A four minute song running to 3.8MB transferred in under a minute, which is around 20 times faster than the D'music MP3 player I reviewed last month. You can also shuffle the order of songs in the player after they've been downloaded too, which is a real advantage.

The other function that I should mention is that you can use the player as a portable hard drive, as it will let you transfer files both into and out of the player. You can upload and download just about any file you like (so long as it fits in the available memory), but there is one limitation: you cannot extract an MP3 file back out of the player. Yes, once it's in there, all you can do is to play it, or delete it. This is, of course, designed to prevent the wanton dissemination of MP3s, but is it really going to be that effective? I just found it annoying and childish, as it is only really play-

Web links

[www.mp3.com]
[www.eatsleepmusic.com]
[www.iuma.com]
[www.listen.com]
[mp3.lycos.com]
[www.mp3.com]
[www.dailymp3.com]
[www.mp3now.com]
[www.mp3-place.com]
[www.mp3spy.com]
[www.rioport.com]
[www.audiofind.com]
[searchmp3.com]

ing lip service to the RIAA, and won't alter the main distribution vector for MP3s: the Net...

How it sounds

When it comes down to it, just about all MP3 players sound pretty much alike. They all use modern Digital Signal Processing (DSP) chips with remarkably low noise levels, and the output audio amplifiers will give you ear-popping volume with no trouble at all.

There are two secondary factors that will affect the audio quality, these being the sample rate of the MP3 file, and the degree of equalisation applied. (Often referred to as 'EQ'.) The sample rate of an MP3 is set when the music file is originally recorded, and more often than not is set to 128Kb/s — a good compromise between file size and audio quality.

If you want better quality sound, you can record at up to 256Kb/s, but you pay the penalty of doubling the size of the resulting MP3 file. Going the other way and recording at 64Kb/s will of course give you a file half the size, but it starts sounding pretty terrible. You can even go down to 16Kb/s if you're desperate...

The other factor that affects sound quality, EQ, is independent of the MP3 file, and is instead applied by the player during playback. You often get a choice of pre-set 'curves' that can be applied, giving you some extra bass or treble boost for example.

The MPIO has a set of four EQ settings, and to be honest, three of them are awful. The 'Pop' and 'Classic' settings are spiky and downright painful to listen to, while 'Rock' pushes the bass up so hard, one of the internal amplifier stages starts distorting.

The result is a clipped, distorted mess, and really isn't up to today's standards. The only setting that is up to scratch is no EQ at all, which rather defeats the purpose of the exercise. This is a shame, as you really need some form of bass boost with a portable player, especially if you're using the in-ear bolas-style earphones supplied.

Ups and downs

The MPIO isn't perfect. Its EQ settings aren't really usable, and it's 'off' battery drain of 1.8mA is quite high — you'd be best off popping out the batteries if you weren't going to listen to it for a couple of days.

On the up side though, 64MB built in is nothing to sneeze at, and you get a Flash Memory card slot as well, so you can expand the memory later. It also has a super file transfer rate, which means that you're not standing around all day filling the thing up with music. Perhaps the most obvious feature of the MPIO that we had in to review is its translucent plastic case — it's just a shame that it won't run on an iMac...❖

(Right) This is where the MP3s go in... The MPIO can handle transfer rates of up to 1.3Mb/s, which is pretty nippy.

(Below) The row of buttons along the top of the player are for volume, track repeat and turning off the DSP -- which we recommend.

MPIO-64SV MP3 Player with voice recorder

Good points: 64MB of RAM, upgradeable to 96MB, the fastest download speed we've ever seen, and it comes in cool '90s translucent blue plastic.

Bad points: 1.8mA drain when 'off', no upload of MP3 files, DSP (EQ) settings need a little work.

RRP: $459. Additional 32MB Flash memory cards are available for around $200 each.

Available: Contact: Juni Australia, 85-89 Asquith St., Silverwater NSW 2128; Phone: (02) 9748 0999; Fax: (02) 9748 0895; Email **juni@juni.com.au.**

Specifications

Size: 66 x 90 x 18mm
Weight: 108g, including 2 x AAA batteries
Power: 1.8mA standby (off)
85mA playing
60mA recording
Memory: 64MB, expandable to 96MB with extra Flash memory card.
Playback time: 60-90 minutes, depending on memory size and sample rate of stored files.
Voice recording time: 4.5 hours

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Keeping your cool

Well, it's summer again, and while there are lots of interesting and fun ways of keeping yourself cool during the summer months, your poor PC is limited to having a fan bolted unceremoniously into its innards. There are a number of rather interesting forms this can take, though, and so I thought I'd take a look at a number of 'cooling solutions' that Jaycar Electronics have on offer.

Jean-Baptiste Cattley

PC Air Circulator

Constructed from sturdy surgical-green plastic, the PC Air Circulator slots neatly into any vacant PCI or ISA slot, and the dual extendable, directable fan heads can swivel independently through 90 degrees, providing cooling where you need it most.

At least, that's the theory. When it comes down to it, the unit is longer than most PCI/ISA cards, so you're limited to pointing it at the CPU and chipset, and on ATX motherboards, this is shielded by the end of the AGP card anyway. It does extract hot air from the case, though, so if your CPU fan is just stirring up the air inside, the PC Air Circulator could be just the thing to reduce the ambient temperature.

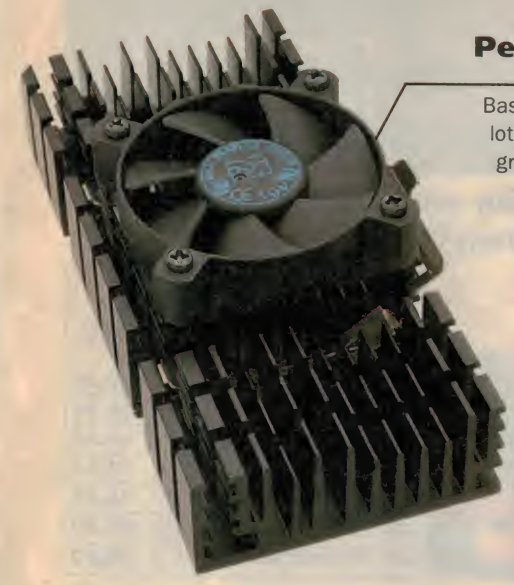
The PCMCIA External Cooling Kit

Unfortunately, I didn't have a notebook to try this on but... well, it just looks cool (pun intended). The PCMCIA External Cooling Kit plugs into your notebook via the PCMCIA slot, amazingly enough, and is powered through the socket itself. There's no fiddling around with cables and installation, you just plug it in and it goes.

It even comes with a leather travel pouch as well, so your flash notebook won't get all scratched up. Power consumption is 0.45W, and of course, you'll have to remove it if you want to use a real PCMCIA card — but there's not much getting round that, is there?

Just Cooler

This fan mounts in a 5.25" drive bay, and sucks air into the computer, through a foam filter. It comes with brackets to mount a 3.5" hard drive behind it, channeling cold air right past the drive. This is one of the noisier fans we tested, and sitting as it does on the front panel, it's a little hard to ignore.



Pentium II cooler

Basically, it's a thumping great heatsink with a fan stuck on the front. There really isn't a whole lot to say about it, but if you're foolhardy to be running your PII *without* a fan, run, don't walk to grab one of these. Oh, and turn off the computer till you get back...

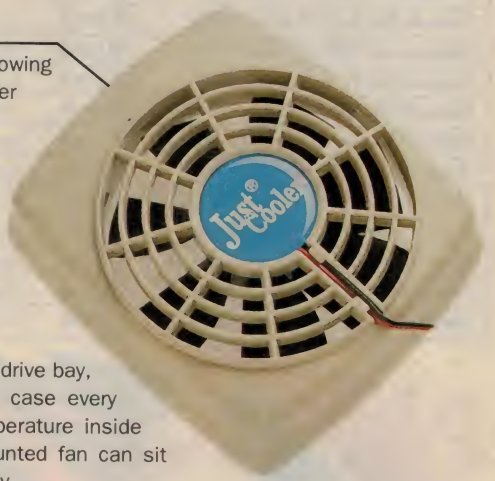
VLSI Chip Cooler

Go on, admit it. You want one of these. At just 135 x 135 x 6.9mm, this fan is just plain cute. It's designed for sticking (via a self-adhesive heatsink) straight onto your chipset, be it on your motherboard, video card, or wherever your system is running a little warm.

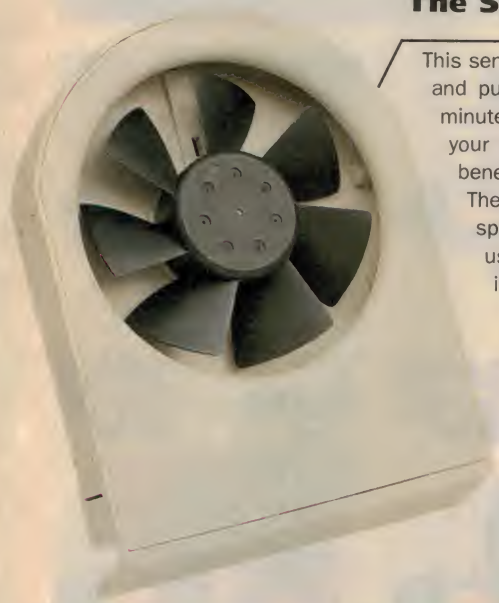
The thing might not shift a whole LOT of air, or dissipate an incredible amount of heat, but every little bit helps... and it looks like it came out of James Bond movie, too.

The Monitor Cooler

Now this is something I've wanted for ages. The Monitor Cooler is simply a 4" upward-blowing fan that sits on your monitor's cooling vents, and sucks a useful 38 cubic feet of air per minute past your picture tube. My 17" Osborne used to verge on being a fire hazard, but with the fan running, it's downright cold to the touch. The fan uses a standard 4-pin PC power connector, via a socket in the included backplate. It's simple, it's cheap, and it works. If your monitor runs hot, you need one of these.



The System Cooler



This sensibly-sized cooler mounts in a spare 3.5" drive bay, and pulls 32 cubic feet of hot air out of your case every minute. As well as reducing the ambient temperature inside your case, the System Cooler's large top-mounted fan can sit beneath your hard drive, cooling it considerably.

There are only two minor drawbacks with the design: First up, not many desktop cases have a spare 3.5" bay below the hard drive, or at least, not with access to the front panel. Secondly, using standard mounting rails, the cooler mounts flush to the front panel, directing the air back into the case. You can mount the drive further forward, but only one of the screw holes will then line up. The thing's not under any mechanical stress, though, so once you get it mounted, this really doesn't matter.

486/Pentium coolers

Again, not much to tell about these, they're CPU-sized heatsinks with a fan on top. The 486 model is rather er, tiny, but if you're an insane rev-head overclocking maniac, you really should get something better than a 486 anyway.

Summing up

PC cooling is a wonderful thing and it can really save you an awful lot of hassles - even outright destruction of your computer in some cases. However, you should be aware that just like vitamins, more than enough of a good thing does no good whatsoever.

If your computer is already stable, and running well, then all the cooling in the world isn't going to improve performance. You might theoretically be able to squeeze an extra percent or two of performance out of your CPU by running it at -40°, but a little extra RAM, or uninstalling that flashy-but-annoying shell enhancement will do an awful lot more. Of course, if you want to try overclocking your machine, then extra cooling is a must, but again, it's time to weigh up the time, money and effort you put into your overclocking efforts, and compare that with the cost of a faster CPU in the first place... ❖

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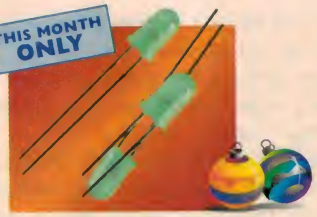

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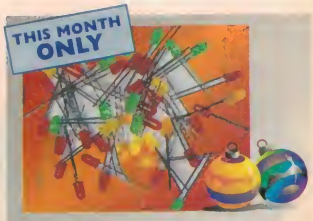

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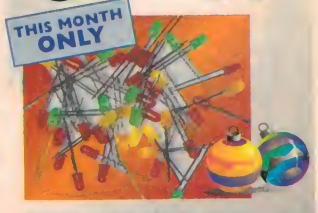

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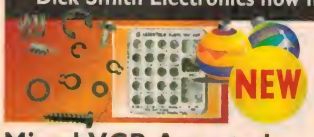

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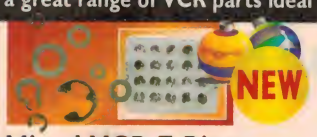

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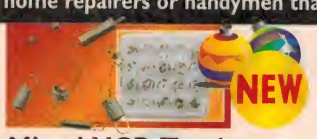

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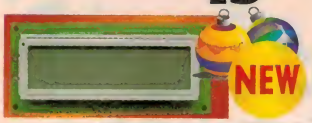

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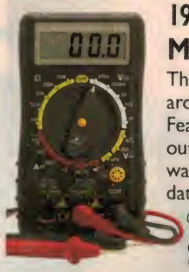

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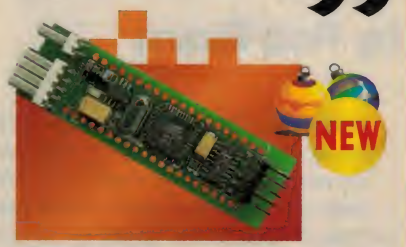

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Take your PIC

Interested in programming a PIC microcontroller for that special application you have in mind? Feel intimidated by the fact that little kids can program a VCR and you can't? Don't despair, because we've taken a look at a few different ways to ease yourself into the fascinating world of PIC micros — one of them just might be the ideal distraction during this holiday break.

by Rob Evans

I really must warn you from the outset that this is a dangerous wordplay zone, since any product that involves Microchip's venerable PIC processor tends to generate a barrage of expressions based on the word 'PIC'. Then again, perhaps this is hardly surprising where catchy names are needed for new PIC-based products, particularly if they're aimed at the beginner. In any case, PIC yourself up, PIC a comfy chair, and we'll show you how to PIC the right PIC learning tool for your needs — and I promise I won't do *that* again...

The Microchip PIC was originally developed during the 1980s as a Peripheral Interface Controller to support the (then) high level 16-bit microprocessors, and as result was designed with a small and efficient instruction set (RISC, in effect) so that it would be both fast and relatively easy to program. Despite these humble beginnings Microchip have continually developed the PIC design over the years, to a point where their lineup now includes microcontrollers that will suit hobbyists right though to industrial designers.

The most interesting chip in their range from a beginners point of view is undoubtedly the PIC16F84; a low-cost, reprogrammable (using flash-technology EEPROM) 18-pin device with a 14-bit core. One of the very appealing aspects of the 16F84 is that Microchip has designed this micro (and many others in their range) with simple in-circuit programming in mind, so that a complicated and expensive programmer is not needed. This of course is an idea situation for experimenters, since thanks to the chip's uncomplicated serial programming interface, a PC-driven programmer can be knocked up from a handful of readily available, cheap components.

While the cost and architecture of the 16F84 have made it an extremely popular micro, an arguably more significant factor involved has been Microchip's excellent support for their products, which is centered around their website at **www.microchip.com**. Amongst a smorgasbord of PIC related information, here you can find full data sheets on the PIC range, a huge variety of project application notes (plus matching PIC source code), FAQs on PIC-related tips and troubleshooting, and best of all, Microchip's free development software; MPLAB. In a nutshell, this level of product support appears to be unmatched by anyone else in the industry, and has played a major role in making the PIC range the most popular choice for microcontroller novices, education institutions and professionals alike.

Microchip's MPLAB is an Integrated Development Environment (IDE) for their PIC16/17 family of microcontrollers, and includes the essential software tools needed for developing PIC applications. That is, the one software package offers a code editor, a PIC simulator/debugger, a programmer 'front end', plus a project manager to tie it all together. The only thing that's missing in this free package is the programmer hardware, which as you might expect, Microchip can supply for a suitable fee — around US$200 for the basic model.

The low-cost but very effective PicFun module: Just plug in a power source and a serial cable to the PC, and you're ready to start programming.

However, as further evidence of Microchip's pragmatic approach to their PIC customers, their website also offers full design information for a low-cost DIY programmer that connects via a PC's standard parallel printer port. This is in their application note AN-589, which includes a detailed schematic diagram for the programmer *plus* the source code (in C) for the interface program on the PC side — you really couldn't ask for more.

So with this sort of impressive commitment to their PIC products through the Microchip MPLAB IDE suite of programs, you may be wondering why any third-party software/hardware alternatives (such as those shown here) are needed. The simple answer is that the MPLAB setup inherently assumes that the user already knows how to write and implement PIC source code, and has the time and ability to construct the programmer's hardware from scratch.

This is not to say that Microchip have missed the mark with MPLAB, by any accounts, since the software really has to be aimed at a level where experienced programmers can quickly develop code using all the available tools. In the end though, a new or inexperienced PIC user is faced with a fairly intimidating software package, plus the need to construct the hardware side of the programmer.

The software/hardware packages we're

taking a look at here are really designed with the PIC novice in mind, but take quite different approaches in introducing you to both the hardware and programming side of PICs. Each of these approaches comes at a very different cost, by the way, so the idea here is not to directly compare the methods but to simply see which one might be right for you, your students, or perhaps your workplace.

PicNPoke

PicNPoke from Melbourne-based Bubble software is billed as 'Multimedia PIC Tools For The Beginner', and is the most elaborate PIC teaching package we've seen. Based on around a dozen software modules that can share code files, the emphasis here is on a very visual and interactive approach to learning PIC architecture and programming — hence the 'multimedia' tag.

The software runs on Windows 95/98 with no special demands on the PC's capabilities, and offers a range of learning aids including simulators, tutorials, plus an assembler and programmer front-end. PicNPoke seems to be a package that has grown over time from a very sound idea; that learning a fairly dry subject can be fun, if done with healthy doses of wit and intelligence.

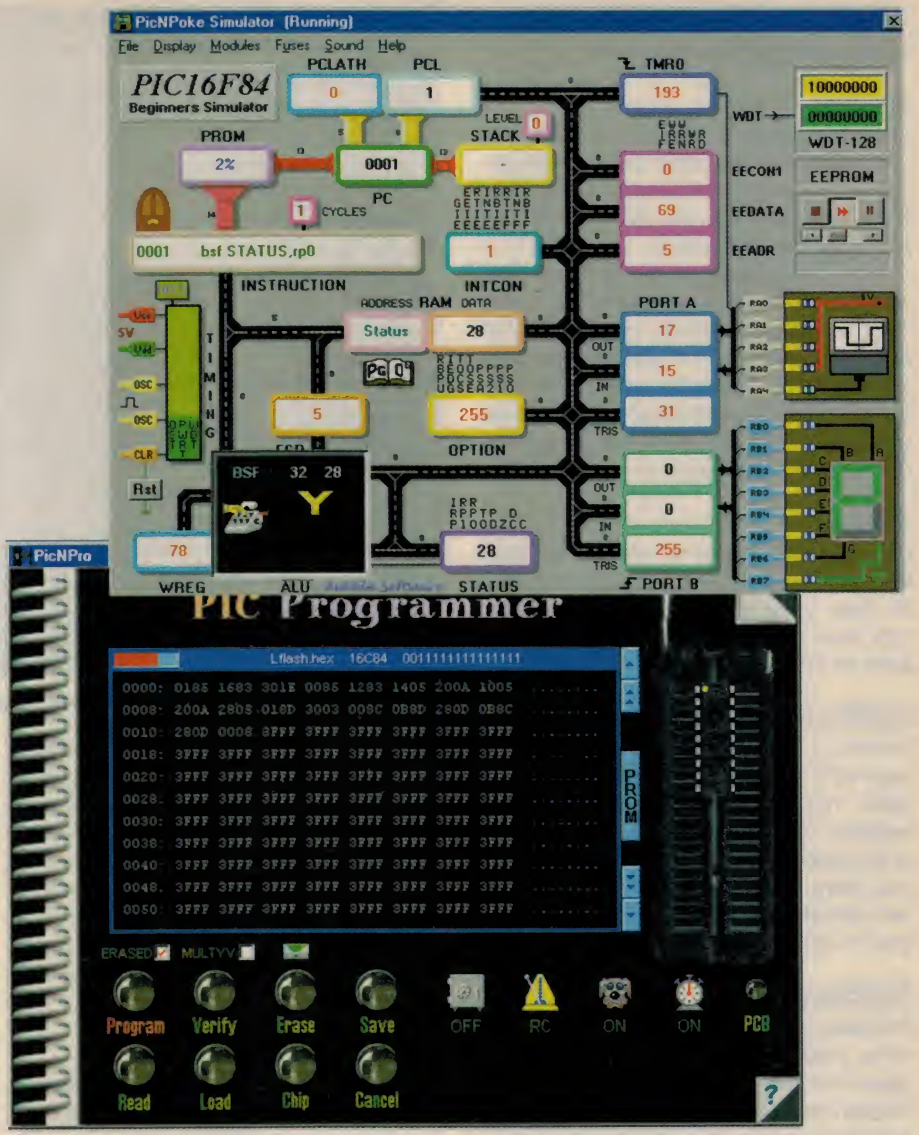
Bubble software has also developed a full experimenters kit, which would suit educational institutions in particular. The kit contains the PicNPoke software, a PIC programmer with the ability to update its own firmware, plus a 'real world' interface with add-on boards. This would provide a school with the essential tools needed to introduce students to PIC hardware and programming, then smoothly lead them though to a point where they're confidently creating their own PIC projects. The full experimenters kit (including the full programmer hardware) is priced at $169 — for the latest pricing options and updates, check out the PicNPoke website at **www.picnpoke.com**.

Here's an overview of the PicNPoke modules:

PicNPoke Simulator

This is really a PIC 16F84 architecture simulator, and provides a (very) animated view into the PIC's internals. Complete with sound effects and cute little animated buses tearing around data and address paths, the PicNPoke simulator can even accept program code so that you actually get to see a program working inside the chip. This is also the case for individual PIC instructions, which means you can find out how an instruction works at the grass roots level, rather than having to run it with a string of other code just so that you can see it's effect.

The PicNPoke simulator really is quite unique, and appears to be where the whole PicNPoke suite of programs started. Some would argue that you don't need to know how the internals of a micro work to use one, but this simulator is so captivating you can't help but learn about what goes on in a PIC.



PicNPoke's animated simulator (top) shows the internal operations of the PIC16F84 in a very entertaining way - you could watch it for hours... The lower screen shot is the main control 'panel' for the PicNPro programmer. Most PicNPoke screens use animation to provide feedback on the program's operation.

PicNPlan

PicNPlan is a mouse-driven code assembler, where all the PIC code instructions and its features are available on the screen. It has quite an elaborate help system which prompts you for the necessary information as you go, so creating PIC code is surprising easy for inexperienced programmers.

There's no need to compile the object code with a separate program with PicNPlan, since this is generated as you go. Also, the assembler's output files are saved in formats that are compatible with other PicNPoke programs, plus the standard assembler listing (.asm) and ready-to-program hex formats.

PicNPlay

PicNPlay is loads of fun, and a very visual, effective way to see you code works in a 'real' circuit. Here, you can create a schematic diagram where you literally connect other electronic parts up to your 16F84, then watch the effect as your program (say, generated in the PicNPlan assembler) runs.

This 'virtual breadboarding' program offers a range parts that can be connected, including a variety of displays (LCD, 7-segment, logic indicators, and so on), different chips (including gates), passive components (resistors and switches), and even test instruments (logic analyser, signal generator, etc). The components are connected with virtual 'wires', so it's a simple matter to rearrange your circuits or add new parts as your code changes — the program is quite fast by the

way, so you see effects almost as if the program was running in a real circuit.

Tutorials

Along with programs that deal directly with code, PicNPoke also offers a number of interactive, animated tutorials to help beginners become familiar with the PIC's architecture and programming functions.

These are PicNPost to learn RAM and ROM addressing tricks, PicNPrac for the chip's interrupts and timers, PicNPort to deal with I/O ports, and PicNPrep for a classroom-style look at the PIC maths instructions (AND, XOR, etc). Then when you've finished all those tutorials, you can do PicNQuiz where you answer randomly generated questions on the PIC 16F84.

Utilities

Here we have HexPic to convert hex data back into standard (PIC) source code, plus DT Type Saver which can help you import data from a spreadsheet or database — great for lookup tables.

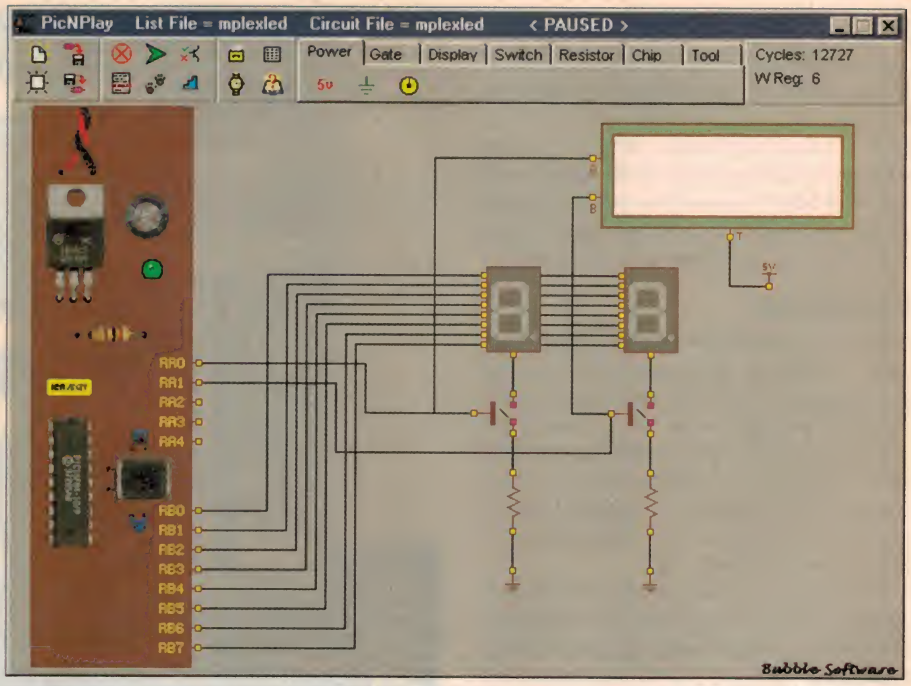
PicNPro Programmer

PicNPro is a PIC programmer which suits most of the PIC microcontroller range, and again, has a user-friendly style graphical interface. It interfaces to the hardware part of the programmer over the PC's serial port, and offers quite professional features such as multi-voltage verifying, where the chip program is checked at 4.75V, 5V and 5.25V.

PicNBasic

PicNBasic is new to the PicNPoke, and as the name implies, allows you to write PIC programs in a familiar BASIC-style language. The program can then compile this into native assembler code ready to program the PIC.

At this stage you need to use Microchip's (free) MPASM assembler to finally program your chip, but this is a quite transparent process thanks to PicNBasic's ability to hook into MPASM when it's needed. PicNBasic should be a boon to those who are well versed in BASIC programming but are unfamiliar with PIC instructions and programming technique. To help all of this along, the program is supplied with a very comprehensive help file in Adobe Acrobat (PDF) form.



The PicNPlay circuit simulator is surprisingly accurate, and loads of fun.

PicFun

PicFun from Labtronics in South Australia was reportedly developed as a result of requests from high school teachers for an easy way to teach microcontroller basics. The PicFun module meets this need by behaving as a reprogrammable, stand-alone control board that can be used for applications such as robotics, alarms, light controllers and so on — so in effect, the unit is a PIC programmer and Logic Controller unit in one small module.

The appeal for schools in particular is that the microcontroller chip doesn't need to be removed for programming, so students can easily move between the programming stage and actually using the module for the chosen task. In practice, this just involves removing an on-board jumper link to change the module from its operating condition to its programming mode — very neat indeed.

Th PicFun kit from Labtronics is very com-

Jaycar's PIC trainer makes a very practical temperature and humidity meter.
As a pure PIC training device though, there's probably better value around...

The clever linking system in the Jaycar trainer's add-on modules (right) automatically change the main unit's function as they're pluggied in.

petitively priced, and includes all of the parts needed for the controller board, plus a rather simple but nonetheless effective program to talk to the unit when in its programming mode. The PicFun programming software is compatible with DOS and all common versions of Windows, and accepts a standard hex PIC source code file, as generated by most assembler programs. In this case, it's assumed that Microchip's (free) MPLAB package is used in conjunction with PicFun, although there's no reason why other code development software couldn't be used — MPLAB is a well know and accepted standard, however.

The module itself is based on the ubiquitous 16F84 PIC microcontroller, where a number of the chip's input and output lines are available at connection points around the board, which also features PCB locations for output driver transistors and indicator LEDs. As you can see from the photograph of our sample PicFun board, the serial programming connection is via a standard DB9 socket while the input/output connections can be made directly to the PCB pads or (preferably) via standard PC-mount terminal blocks. The module can be powered from a 3 to 6V source by the way, and the input lines are voltage-protected by series resistors, which as you might imagine is an important feature for a microcontroller device used in schools.

Labtronics seem to have done a very effective job of developing a microprocessor training aid that's robust, useful and attractively priced for both educational and professional applications. The complete kit is priced at just $25 ex tax and $28.30 including sales tax, but watch out for an even lower pricing structure after the GST takes effect in June 2000. Labtronics are also in the process of developing training course material and PIC applications that are suitable for schools, however these should also be available to the general public as they are finalised.

If you'd like to get into PIC programming with a minimal outlay in time and money terms, PicFun is hard to beat. Labtronics has recently been appointed as a consultant for Microchip Technology Inc (USA) and has entered into a partnership program for developing further PIC-based products. You can find additional information on PicFun and its latest developments though the Labtronics website at **www.chariot.net.au/~labtron**.

5-function PIC trainer

Jaycar are currently offering a compact multifunction PIC 'trainer' featuring a 16 x 2 character LCD, display and three plug-in modules to change the unit's function. The modules change the unit's function to a temperature and humidity meter, a counter/timer or a four-channel analogue to digital converter, by simply plugging the function module into a socket on the main board. Unlike the other PIC units shown here, the PIC trainer is based on a pre-programmed PIC 16C71, which amongst other features, offers A/D converter inputs.

While offered as a training module, this unit is rather more of a demonstration board for the 16C71 chip, and at the same time offers a number of useful preset applications — many people would find the temperature and humidity sensor function is particularly useful, as this gives a clear display of both variables on the LCD. It could of course be developed for other applications thanks to the versatility of the PIC chip itself, but for real grass-roots beginners, a simpler unit based on the 16F84 may be a better choice.

The multi-function PIC trainer is priced at $109, makes a quite effective humidity and temperature sensor unit, and is available from Jaycar stores around Australia. ❖

High power motor controller — 1

Here's a design for a compact and efficient electronic speed controller for DC motors. It operates on voltages up to 50V, and can handle currents of up to 750 amps. We developed it as a speed controller for a battery powered vehicle — but this design is suitable for almost any DC motor speed control application.

by Ron Badman ZL1AI, and Brent Brown

This controller was developed as a simple variable speed controller for a three wheeled 24V battery powered utility vehicle, which is used to move heavy equipment around a hilly polytechnic campus.

The vehicle initially used a stepped resistance controller giving two speeds, but it had suffered a meltdown and needed major repair work. Considering the cost of the high current relays, the work required in repairing the high-power resistors, and the poor overall performance of the design, it was decided that an electronic speed controller would be a viable option.

Armed with just a few basic ideas like efficient PWM control, power mosfets for switching and a cable operated slide potentiometer for an accelerator, a design began to take shape.

Stall current

For our design we needed to find the absolute maximum current that the controller had to be able to handle. To determine the stall current of the motor, we placed the vehicle's front wheel against a wall (with the handbrake on as well), connected the batteries to the motor through a contactor (a large relay), and switched on. Our DC clamp-on ammeter read 460 amps. We quickly switched the power off again before the motor melted...

This was our starting point; the controller had to safely handle at least 460 amps, plus a margin to allow for other things like new fully charged batteries, heavier wiring, changes due to temperature, etc. In view of the delicacy of semiconductor junctions, we allowed for a margin of about 40%, deciding that a controller that could handle 750A max would be OK.

A word of caution here: Before carrying out a stall test on your own motor, especially if you are using temporary wiring for this purpose, you must have some idea of the expected current. You also need to use a suitable ammeter, adequate wiring, and an adequate contactor or switch. You should never switch on by touching two cables together, as the flash could injure you.

Also, if it isn't adequately secured, there is the risk that the vehicle or motor could break free, causing damage to you, the mountings, or to the motor shaft and brushes. This risk must be assessed by the builder, and if it is deemed unwise to do such a test, then some other means must be found to estimate the maximum current that the controller has to handle.

The 'Mebea' electric utility vehicle — not the prettiest thing on three wheels, but an ideal candidate for this high power motor controller project.

Which mosfets?

When choosing which particular N-channel mosfet to use, a search of electronics catalogues showed a number of mosfets with 50 to 100 amp, and 50 to 200 volt ratings. As the maximum current for this kind of package is 75A, we chose the Fairchild Semiconductor NDP7050 for the job (it replaces the National Semiconductor NDP705). In a TO-220 package it is rated at 75A continuous, 225A peak, 50V, 15 milliohms max, and was also the lowest cost one we could find.

10 of these in parallel would give us the 750A we needed, and they also have a fully rated internal source-drain diode. We could make use of this in our design for the diode module, as well as having the diode act as a transient voltage suppressor. The NDP7060L, a similar device but rated at 60V with a 5V gate drive would also be a very good choice, especially if you want to use the controller with a 48V motor.

Another word of warning — just because we said that 10 of these power mosfets would give us a rating of 750A continuous and 2250A peak, it doesn't mean to say that they will be bulletproof. One accidental short circuit where large 12V automotive batteries are concerned, and you will almost certainly blow all of the mosfets instantly!

Power mosfets are suitable for parallel operation because of their negative temperature coefficient characteristic, which helps

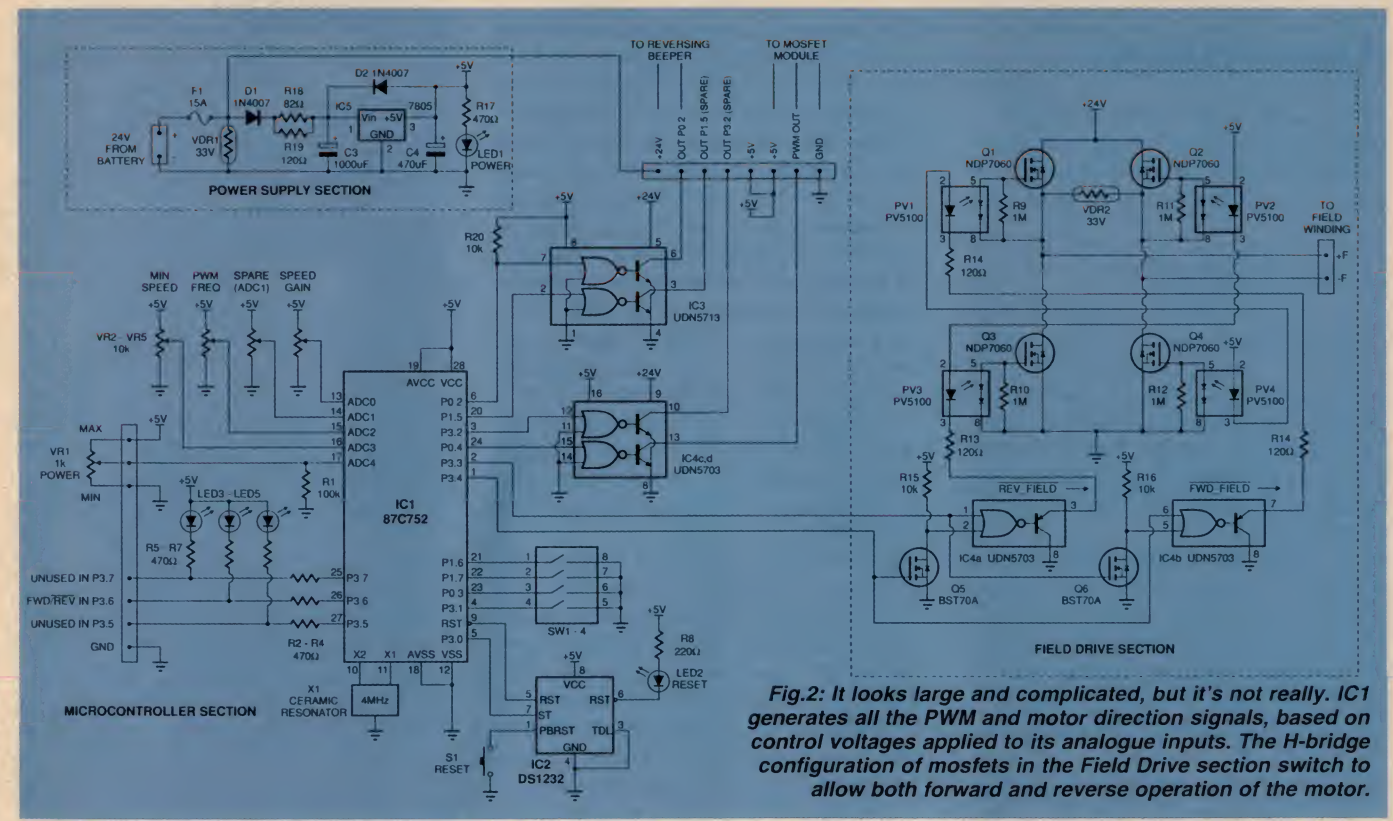


Fig.2: It looks large and complicated, but it's not really. IC1 generates all the PWM and motor direction signals, based on control voltages applied to its analogue inputs. The H-bridge configuration of mosfets in the Field Drive section switch to allow both forward and reverse operation of the motor.

them to share load current evenly between devices. However, because of the large currents involved and the risk of catastrophic damage that could arise from a device failure, it is recommended that all 10 devices that are installed in a module be out of the same production batch, so that they are more likely to be closely matched and run at the same temperature.

Just how hot the mosfets are going to get in operation takes a little working out. Ignoring the fact that there are some switching losses as the mosfet quickly goes through its linear region between its on and off states, the main component of power dissipation in the power module mosfets is because of I^2R heating while the mosfet is 'on'.

The worst-case dissipation from the mosfets in the power module occurs at 100% duty cycle, which in our case could be up to 750A. This would mean that our mosfets, with a 1.5 milliohm 'on' resistance, conduct 750A for 100% of the time. Power dissipated by the mosfets under these conditions would be $750^2 \times 0.0015 = 844W$. This is 84.4W per device, well within their maximum rating of 150W at 25°C.

The worst case dissipation in the diode module occurs at 50% duty cycle, which could be up to 375A. As the diode conducts for only half the time, and drops 0.9V, the power dissipation would be 375 x 0.9 = 338W. This is 33.8W per device.

Due to the physical layout of the power and diode modules, the mosfets have good thermal conductivity through to the aluminum mounting frame, and we found that a heatsink of the same area as the frame, with fins about 50mm deep, proved more than adequate. Also, there is sufficient bulk of aluminium to soak up heat generated by short periods of heavy loading. In practice we found that even after heavy use the modules get warm, but not hot.

How it works

We'll start with the main control board, which is made up of three sections: the microcontroller, the field drive, and the power supply.

The microcontroller we used is the Philips 87C752, which has a built-in PWM generator, five A/D inputs, 2K of EPROM, and uses the very popular Intel 8051 instruction set. IC2, a DS1232, provides power-on reset and a watchdog timer that expects regular strobe pulses from the microcontroller, or else it will time out and generate a hardware reset.

These strobe pulses are programmed in at strategic points throughout the software, and if normal program execution fails for any reason, the watchdog will reset the microcontroller and the program will restart. This is a safety feature to protect against external influences such as EMI or electrostatic fields.

Referring to Fig.2, the microcontroller (IC1) reads the voltage across the power control (accelerator) potentiometer, RV1, and across the preset pots RV2, RV3, RV4, and RV5, using its A/D inputs. The microcontroller generates a PWM output on port 0:4 (pin 24), whose duty

Features

This is a DC motor controller with high efficiency, and smooth variable control of motor torque, using Pulse Width Modulation (PWM) control of power to the motor.

Very compact opto-coupled power module, using ten power mosfets in parallel. Able to handle 750A continuous, 2250A peak, with a maximum on resistance of just 1.5 milliohms. Rugged design with transient suppression.

Forward/reverse switch input for electronic direction control of shunt wound motors.

A single chip microcontroller design makes the controller both compact and flexible, with a watchdog timer to ensure stable and reliable operation.

Software control of speed characteristics to suit the vehicle.

Different forward and reverse characteristics are available.

Potentiometer input for accelerator, so that any kind of hardware arrangement may be used, e.g. twist grip throttle, thumb press lever, foot pedal accelerator.

Software turns on power to the motor's field winding only when required, which saves energy.

Adjustments such as zero speed, speed gain and PWM frequency are done with preset potentiometers connected to ADC inputs on the microcontroller. This allows simple 'tuning' of the controller characteristics to suit the accelerator potentiometer and motor used.

Suitable for almost any type of DC motor, great for small electric vehicles.

The design may be extended for higher currents with multiple power modules.

Types of motors

This design most specifically suits a shunt wound motor, but here are a few notes on various types of DC motors, and how the controller could be used with each one.

SHUNT WOUND

This has an armature winding (via brushes and commutator) and a separate field winding. This controller provides high current variable power to the armature winding for varying the speed. The controller also provides power to the field winding, which establishes a magnetic field for the armature to turn in.

Forward, reverse, or no power is applied to the field winding, for forward, reverse, or no motion of the vehicle. It is a significant point that the field current is usually much lower than the armature current, and so we chose to reverse the field current in order to reverse the direction of the motor.

However, because the field winding has a much higher inductance than the armature winding, it stores a great deal of energy, and this is taken into consideration in the design.

PERMANENT MAGNET

Perment magnet motors have an armature winding, and use permanent magnets for the field. If you have a permanent magnet motor, you need to be able to reverse the armature connections to change the direction of rotation.

You may use a contactor (high current relay) to do this. Alternatively, you could use four power modules to make a full bridge configuration, which would allow for electronic reversal of the armature voltage. In this case the field section of the controller would not be required. These modifications are not covered in this article.

COMPOUND WOUND

This has an armature winding, a field winding that is in series with the armature, and a separate shunt field winding. If you wish to use the controller with a compound wound motor, and you want forward/reverse control, you must modify the motor to bring the armature winding out (separately from the series field winding) to a reversing contactor. The shunt field would now require just on/off control. The modifications to do this are not covered in this article.

cycle and frequency is controlled by the software. The PWM output is buffered by one section of IC4 to screw type output terminals, and then by a cable to the power module (Fig.3).

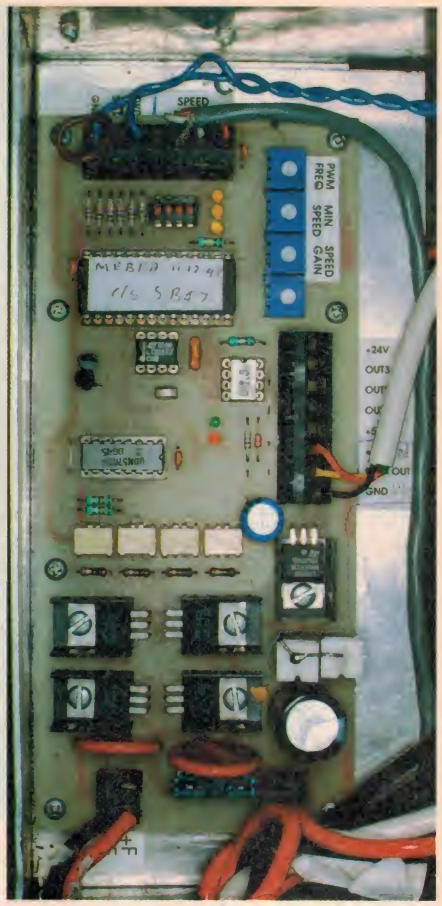
In the field drive section, the field on/off and direction signals are controlled by the microcontroller on pins 1 and 2. These signals control the power to the field winding, using four mosfets in an H-bridge configuration. Each mosfet is driven by a PVI photovoltaic optocoupler. These devices simplify the circuit design by providing a non-ground referenced ouput voltage, which is necessary to drive the two high-side mosfets, as well as providing galvanic isolation.

On startup, pins 1 and 2 of IC1 are at logic '1'. This turns off IC4a and IC4b, no current flows in any PVI device, the field control mosfets have zero bias, and so the field winding is turned off.

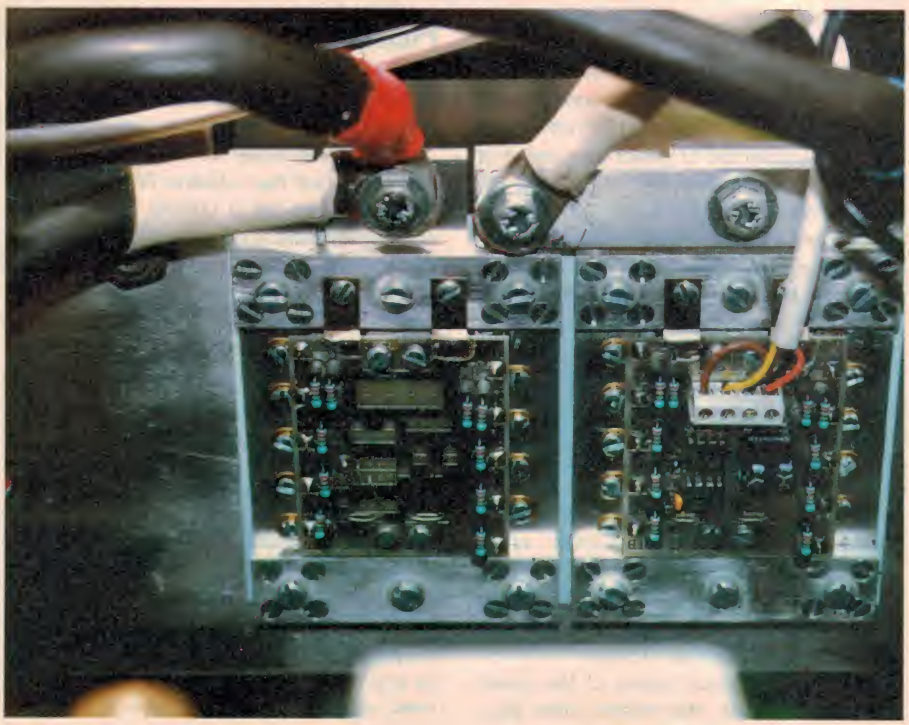
A '0' on IC1 pin 1 pulls the output of IC4b (pin 7) low, causing current to flow in the LEDs of PVI1 and PVI4. These photovoltaic devices now generate about 10 volts at their outputs. Mosfets Q1 and Q4 are turned on, and 24V is applied through the field winding to ground. The '0' on IC1 pin 1 also turns Q5 off, disabling IC4a to avoid any possibility of all four mosfets turning on together (which would blow the fuse).

Similarly, a '0' on IC1 pin 2 turns on Q2 and Q3, so that reverse voltage is applied to the field terminals to allow the motor to operate in the reverse direction. The state of IC1 pins 1 and 2 is always under control of the software.

The power supply uses a simple three terminal regulator, IC5, with voltage dropping resistors R18 and R19 used to reduce the power dissipation in the regulator when operating from a 24V supply.



Top:
The main controller board, wired into the vehicle.
Bottom:
A close-up of the power and diode modules installed in the vehicle. Note that the same PCB is used for both modules.



Power module

The power module circuit is shown in Fig.3. Here, the PWM signal is received from the microcontroller board, and coupled by the HP4502 opto-isolator (OPTO1) to the mosfet driver chip IC1. The opto-isolator is used to avoid any spurious oscillation, feedback, or damage to the main board due to the heavy currents flowing in the power unit. Also, because the power module is completely isolated from the microcontroller board they can potentially operate from different power supplies.

Now, the method of driving the mosfets is very important. When one of these mosfets is turned hard on (this takes at least 10V of bias) it will drop about 1.125V at 75A (due to its 15 milliohms typical 'on' resistance). Thus it dissipates about 84W, which is well within its maximum rated value of 150W at 25°C.

When switched off, there is obviously no current flow so the dissipation is zero. But if the mosfet is biased only partly on, so that it drops half the supply voltage at about half the current (ie. 12V at 42A), the dissipation is now over 500W, well over three times its maximum rating, and it will die very quickly. It is therefore important to ensure that the gate voltage supplied is always sufficient to turn the mosfets hard ON.

Note also that while the mosfets have a high input resistance, they have a very substantial gate input capacitance, and to change the gates suddenly from 10V to 0V or vice versa, requires a high current pulse from the driver. If the driver cannot supply sufficient drive, the mosfets will change slowly between on and off states, with an appreciable time spent in the intermediate high dissipation state, and again they could be destroyed. So for the experimenters out there, beware of changing the design of the drive circuitry unless you are sure of what you are doing.

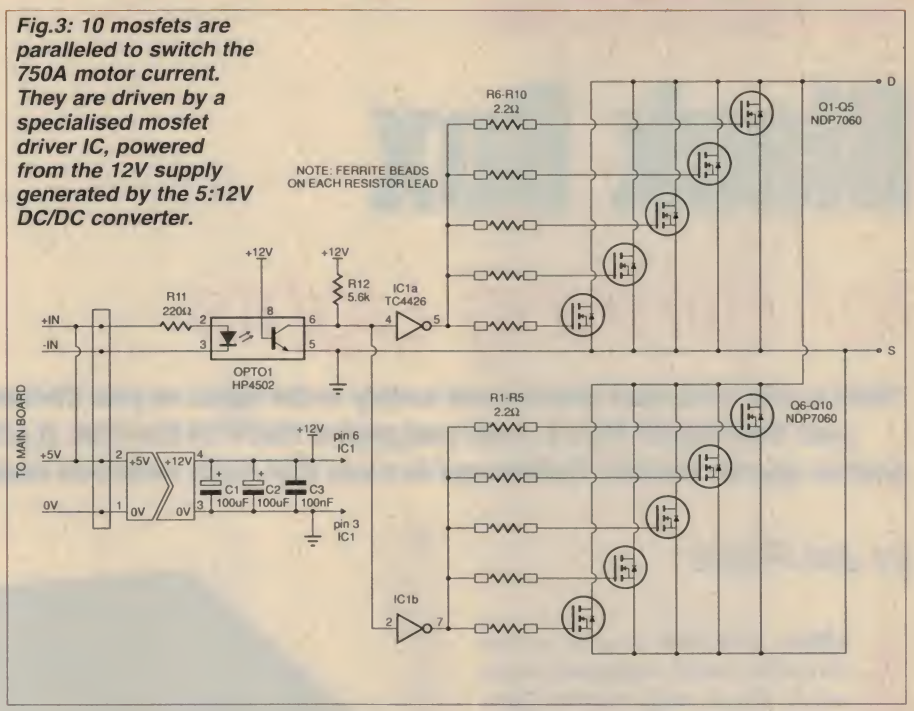


Fig.3: 10 mosfets are paralleled to switch the 750A motor current. They are driven by a specialised mosfet driver IC, powered from the 12V supply generated by the 5:12V DC/DC converter.

To meet the abovementioned requirements, a TC4426 mosfet driver was chosen. It is a 1.5A dual high current driver, which can drive the mosfets with their combined input capacity of 36nF, at up to ultrasonic frequencies. Each of the drivers in the dual package is used to drive the paralleled gates of five mosfets.

The driver runs off 12V, so that at least 10V drive is available to turn the mosfets hard on for minimum resistance. The 12V supply is provided by an isolated 5V to 12V DC-DC converter. Together with the optocoupler already mentioned, this keeps the whole power module galvanically isolated from any other circuitry, and provides a 5V only interface to the microcontroller board, for ease of use.

Because the converter is stepping up from 5V, the gate drive 12V supply can be maintained even if the main battery voltage falls significantly.

That more or less covers the design of this high power motor controller, and is about all we have room for this month. Next month we'll look at the construction and testing of the unit, so stay tuned...❖

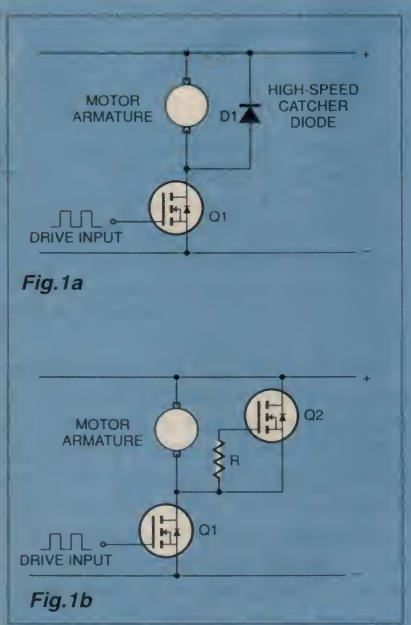


Fig.1a

Fig.1b

Principles of pulse width modulation

Pulse Width Modulation (PWM) control of the motor is used, because it is a simple and efficient method of giving fully variable power control from 0-100%. Note that this design does not include speed feedback from the motor, which means that the accelerator position dictates the torque available from the motor, not the speed. The driver of the vehicle has to apply more accelerator when going uphill and less when going downhill, just the same as driving a car (one without cruise control that is!).

Fig.1a shows the principle of PWM operation with a DC motor. The voltage applied to the motor armature is chopped on and off by power mosfets acting as a switch. The average voltage applied to the motor armature, and hence the current and power, is controlled by varying the duty cycle (on/off ratio) of the mosfet switches.

When the mosfets are turned on, voltage is applied to the motor. Due to the armature inductance, the current does not immediately jump to its steady state value, but starts to rise. When the mosfets are turned off the energy stored in the armature inductance keeps the current flowing in the same direction.

The polarity of the voltage across the armature reverses as the magnetic field collapses, and so the freewheeling diode D1 becomes forward biased, and the armature current now flows through it, and decays gradually. Thus the current in the armature is not a square wave like the applied voltage, but rises to a value depending on the motor load and PWM ratio, with some ripple on it at the PWM frequency.

Fig.1b shows how we used the inherent source-drain diodes in a mosfet for the freewheeling diode, because this was a cheaper and more practical option than using specialised high speed/high current diodes.

Black Box

for Blinking Lights

Want to add a bit more interest and variety to the lights on your Christmas tree? Or those you hang around your front porch? Here's a low cost project that'll do the trick. It will 'blink' two different sets of lights, each in 'pseudo random' fashion and in a way that limits switch-on surges so the lamps tend to last longer.

BY JIM ROWE

AROUND THIS TIME of year, as the Christmas season approaches, many people like to hang coloured lights around their front porch, in a window or two, or perhaps just have a string or two of 'fairy lights' on an ornamental Christmas tree. And in all of these situations the result tends to be more satisfying if the lights are made to blink on and off.

That's when some of the hassles can begin. Most of these light sets consist of low-power incandescent lamps connected in series, for economy, and the traditional way of making them blink on and off is to use a bi-metal switch — a crude 'thermal oscillator'. These are OK in themselves, but they simply turn the power to the lamps on and off, and at a fixed rate. Which is not only a bit boring, but tends to reduce lamp life because of the current surge each time the power is switched back into the cooled filaments.

If you've used a series-string of lamps in this way, you'll know that blown lamps are pretty common. And when one blows, the complete string generally goes out until you find the dud and replace it. This isn't easy, either; without a multimeter, you are generally forced to substitute a known good lamp for each one in the string, until you find the culprit.

The idea of this little project is to help solve some of these hassles. First of all it will blink either one or two sets or strings of mains-rated lamps, in a varying 'pseudo random' manner for greater visual interest. Although the blinking of the two sets is actually derived from the same source, they blink at different rates and times so they appear to be independent.

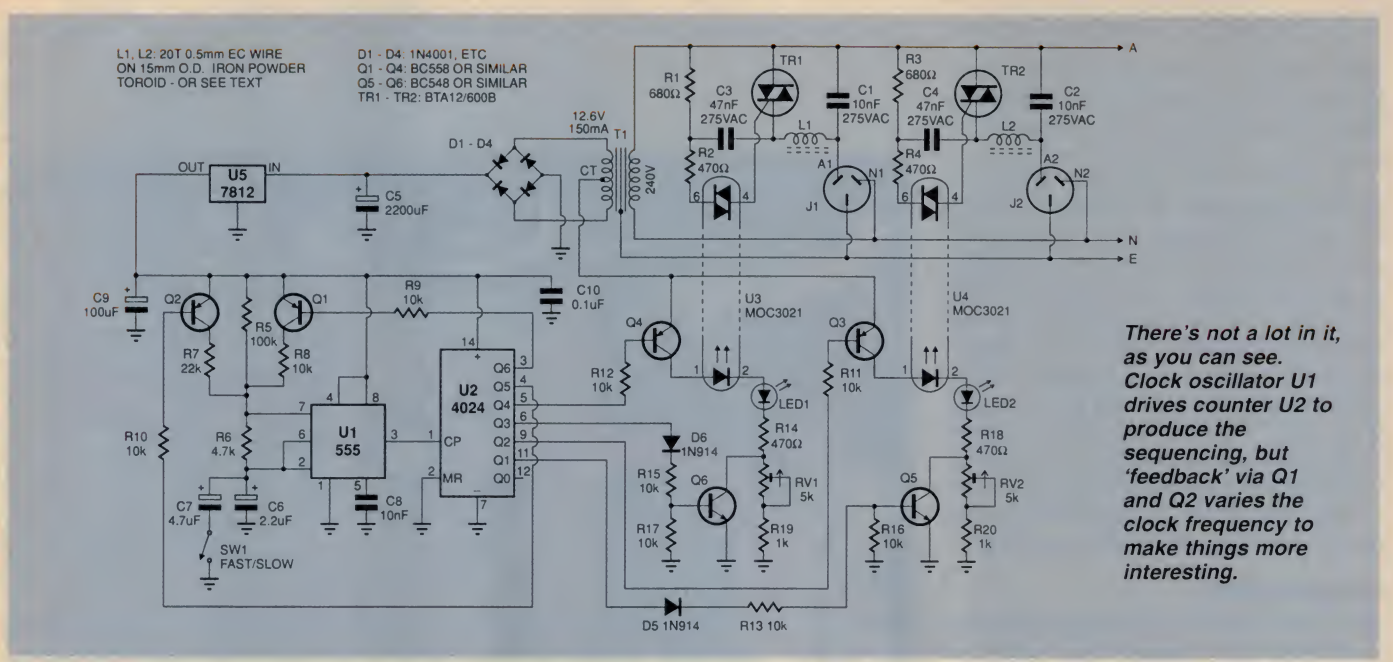
In addition, the power to the lamps is not simply switched on and off, but always applied in a two-step manner so the lamps are briefly 'warmed up' at lower power before full power is applied. This reduces the turn-on current surge, and should therefore extend the lamp life significantly.

Now there are various ways in which all of this could be done, and I actually tried a number of them during the development of the project. However as you'll see shortly, I finally settled on a very straightforward 'dumb' hardware system because it seems to achieve what's needed with a minimum of complexity and cost.

There's no microcontroller, no fancy programming and no ability to vary the blinking sequence — just a low cost 'black box' that can blink one or two sets of lights in a fixed semi-pseudo random manner, at either of two fixed speeds selected by the one control switch. You have a choice of either fast or slow.

It's also quite easy to build and get going. However before continuing I should stress that as the project involves switching 240V mains power, part of the circuit board and some of the components are 'live' when the unit is operating — and therefore a potential safety hazard. So it's definitely NOT a project for beginners. It should only be tackled by those with experience in working with dangerous voltages, and even if you're in that category you should exercise the appropriate level of caution.

Although the PCB and physical layout have been designed to minimise the safety risks, the project should only be connected to the 240V power when the PCB is properly mounted in the plastic box as shown, and with all other components fitted and fully interconnected using properly insulated wiring. The box lid should only be removed briefly to adjust the two preset pots during setup (as described later), and then fitted and left in place whenever the project is used.



There's not a lot in it, as you can see. Clock oscillator U1 drives counter U2 to produce the sequencing, but 'feedback' via Q1 and Q2 varies the clock frequency to make things more interesting.

How it works

As you can see from the schematic, there isn't a lot in it. Just a 'timing sequencer' using a 555 timer (U1) driving a 4024 binary counter (U2), which in turn controls a pair of triacs via some transistors and two optically-coupled trigger devices. But I *have* had to pull a few tricks to get this simple circuit to perform the desired 'pseudo random', two-level power control...

The 555 is connected in fairly standard fashion as an astable oscillator, with its basic timing determined by resistors R5 and R6, with capacitor C6 (plus C7, when SW1 is set for 'slow' operation). The output from pin 3 is then fed directly to U2, which counts the incoming pulses. Outputs O0 to O6 thus change in the usual binary fashion, as the counting proceeds.

What then is the purpose of transistors Q1 and Q2, driven via R9 and R10 from the two most significant bit outputs of U2? Ah — these are used to vary the speed of U1, so that the clock frequency it generates is varied up and down from time to time, to give the sequencer a more complicated 'pseudo random' flavour. (It's not a true pseudo-random sequence generator, I know, but it works surprisingly well.)

So for the first 32 counts of U2, where outputs O5 and O6 are both low, Q1 and Q2 are both turned on and accordingly shunt R5 with both R7 and R8. This gives an effective charging resistance of only 6.4k between pin 7 and the +12V rail, so the 555 oscillates at a fairly high rate. Then when O5 goes high, Q2 turns off but Q1 remains on — leaving R8 in parallel with R5 and allowing the 555 to slow down a bit, for a further 32 counts.

On the 64th count, O6 goes high but O5 goes low again, so Q1 is turned off and Q2 turned on, shunting R5 with R9 alone — allowing the 555 to run slower again, for a further 32 counts. Then on the 96th count, O5 goes high again so both Q1 and Q2 are turned off, leaving R5 alone as the charging resistance and allowing the 555 to run at its lowest rate for the final 32 counts. Then at the 128th count the 4024 returns to the 'all zeroes' condition, and the process begins over again.

The nett result of all this is that although the outputs of U2 basically count in a standard binary manner, the speed varies up and down quite a bit. This gives a worthwhile degree of complexity to the resulting timing sequence.

As you can see the O1 - O4 outputs of U2 are used to control the current fed to opto-coupled triac drivers U3 and U4, which in turn control triacs TR1 and TR2, to vary the power fed to our two light channels (which plug into sockets J1 and J2). Outputs O3 and O4 control one channel, while outputs O1 and O2 control the other.

Both channels work in the same way, which is designed to ensure that their lamps always receive a partial or 'dim' power level before they receive full power. This works as follows:

First, current can only flow in the input LED of each photo driver when the PNP transistor connected to its anode is switched on. These are transistors Q4 and Q3, and as you can see the bases of these are driven from the *higher-order* output of each pair from U2 (i.e., O4 and O2 respectively). So these transistors are turned on only when their corresponding output from U2 is low.

Now when either of these transistors is turned on, current is able to flow through its associated photo driver LED, through the separate visual indicator LED (LED1 or LED2), through current limiting resistor R14 or R18, and then through either RV1 and R19, or RV2 and R20 as the case may be. And we adjust RV1 and RV2 so that in each case, the current that flows in this mode is just enough to have the photo driver trigger its triac into conduction about halfway through each half-cycle of the AC mains power. So RV1 and RV2 are used to set the 'dim' power level for each channel.

To produce full power from each channel, we use the lower-order output of each bit pair from U2 (i.e., O3 and O1) to turn on NPN transistors Q6 and Q5, via diode-resistor combinations D6-R15 and D5-R13 respectively. And when each of these transistors is switched on, it shorts out the associated preset pot and resistor, to allow a much larger current to flow in that channel's photo driver. This then triggers the triac much earlier in the mains half-cycle, to deliver virtually full power to the lamp load.

How do we ensure that each channel always receives low power before full power, to give maximum lamp life? Simply by the way the PNP transistors are driven by the higher-order output of each bit pair from U2, and by taking advantage of the way the binary counter works — by counting up from the 'all zeroes' state each time. This means that each higher-order output will always be low (turning on the PNPs) before their associated lower-order output goes high (to turn on the NPNs).

As you can see each opto driver is connected to the gate of its triac via the usual current limiting and dV/dt limiting circuit, using R1/C3/R2 and R3/C4/R4 respectively. And the output of each triac is provided with an LC filter (L1/C1 and L2/C2) to reduce EMI from the switching.

Transformer T1, a standard low-cost 12.V/150mA stepdown unit, is used to derive a low voltage supply for the sequencing cir-

cuitry. Diodes D1-4 form a rectifier bridge, whose output is smoothed by C5 and then regulated to +12V by U5. This is then used to power U1, U2 and their associated circuitry.

Opto driver control transistors Q3 and Q4 are not powered from the regulated +12V rail but from the centre-tap of the transformer, which provides a rectified but unfiltered supply of about 9V peak. This not only prevents interaction with the sequencer circuitry, but also makes it easier to set the 'dim' triggering level for each channel using the preset pots. The high ripple content in the supply direct from the transformer gives a trigger waveform which effectively allows the pots to vary triggering *phase* along with current level — which is desirable, as opto drivers and triacs can vary quite a bit in their sensitivity.

Construction

As you can see all of the blinker circuitry fits comfortably into a standard 'UB2' size plastic utility box, measuring 196 x 113 x 64mm. Apart from the power transformer, fast/slow switch and 240V output sockets, everything fits on a small PC board measuring 101 x 90mm and coded 99XLB12.

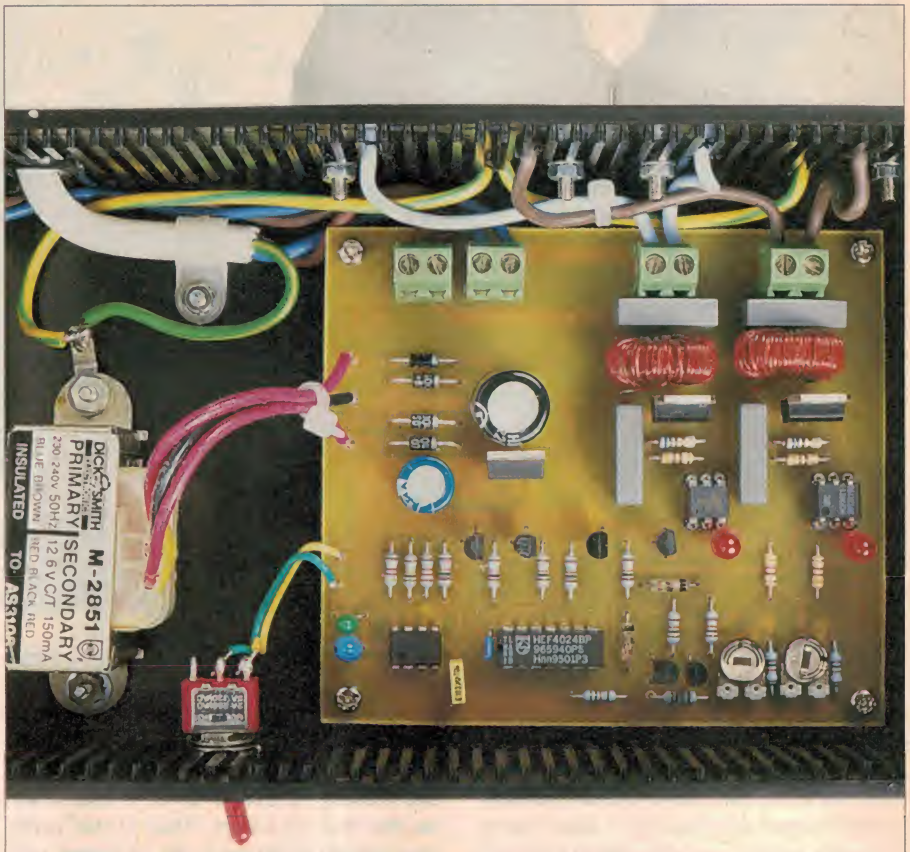
All of the 'live' mains connections to the PCB are made via screw terminal blocks mounted directly on the board, along its rear edge, while the triacs and other live components are grouped in the rear right-hand corner of the board, behind the opto drivers. This hopefully minimises the risk of accidental shock even when the box lid is removed for adjusting the preset pots — which are right at the front.

The power transformer for the low-voltage circuitry is mounted alongside and to the left of the PCB, in the bottom of the box, with the fast/slow switch mounted on the front. The two three-pin mains outlet sockets mount on the rear of the box, while the mains inlet cord enters via a grommetted hole at the left rear, and is securely clamped.

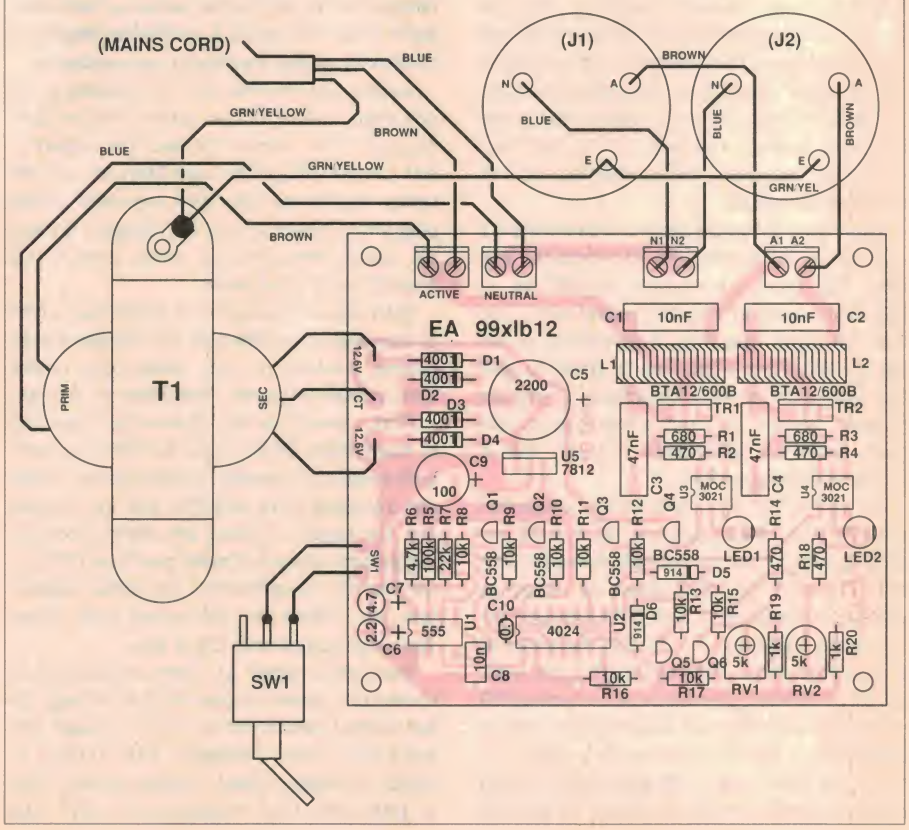
Assembly of the PCB should be quite straightforward if you use the internal photo and overlay/wiring diagram as a guide. Begin by fitting the PCB terminal pins for the transformer secondary and fast/slow switch connections first, followed by the low-profile resistors and diodes. Then you can fit the two preset pots, and the various capacitors. As usual, take care with correct orientation of the polarised parts.

As this stage you can fit the screw terminal blocks along the rear of the PCB, making sure their 'open' wire-entry sides are all facing outwards. They're all two-way blocks, to keep everything simple.

Now fit suppression inductors L1 and L2, winding them first if you aren't using prewound parts. If you do elect to wind your own, use 20 turns of 0.5mm enamelled copper wire on an iron powder toroid 15mm in diameter, such as that sold by Dick Smith



Use the photo above and the overlay/wiring diagram below as a guide when you're building your own unit. Note that all of the 'mains' wiring should be done using wire with suitable mains-rated insulation.



Electronics (Cat No. R-5410). Otherwise you can use the small pre-wound chokes sold by Oatley Electronics.

All that remains is to add the transistors, LEDs, ICs, opto drivers and triacs, taking care in each case to fit them with the correct orientation as shown. Also be careful not to confuse the four PNP transistors with the two NPN types; mistakes here would produce some weird symptoms later.

By the way you may notice that I used sections of SIL socket strip to make 'sockets' for the opto drivers on the prototype board shown. This was purely to let me try a variety of MOC3021 devices, during testing. Sockets shouldn't be necessary in your unit, though; U3 and U4 can be soldered into the PCB just like the rest of the semiconductors.

Note that the triacs themselves shouldn't need to be fitted with heatsinks, for most likely applications of this blinker unit. Without heatsinks they seem to be able to cope with loads of up to 150 - 200 watts (each channel), which should be more than enough for most purposes.

Your board assembly should now be complete, so after checking it carefully for errors and accidental solder bridges etc., it can be put aside while you prepare the box. This mainly involves drilling and reaming out the holes for mounting everything and running the wires to the output sockets, etc. The exact location of the mounting and lead holes for the sockets will of course depend on those you use.

You may also want to fit four adhesive rubber feet to the bottom of the box, to prevent scratching from the heads of the screws used to mount the transformer and PCB.

I'd then bring in the mains cord through its grometted hole, after removing about 60mm of the outer sleeving to make the three wires available for connections, and baring/tinning about 6mm of each wire. Clamp the cable securely with a nylon clamp about 5mm back from the end of the sleeving, and solder the earth wire to the mains transformer earth lug.

Now fit the three-pin output sockets, after which you can connect short lengths of mains-insulated wire to their various screw terminals — making sure that the green/yellow earth wire is long enough to run comfortably to the transformer earth lug.

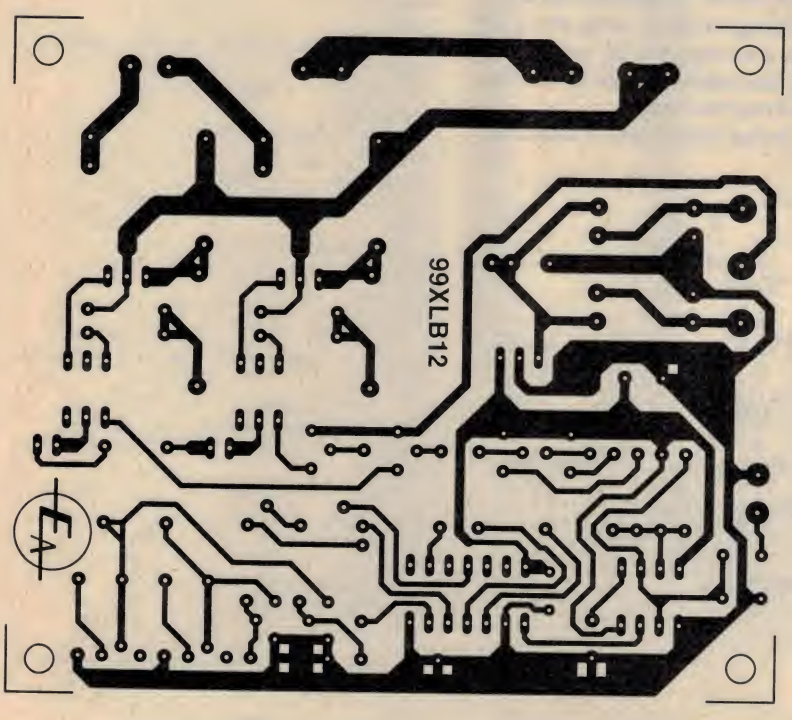
It's also a good idea to fit the fast/slow switch at this point, soldering two short lengths (about 50mm) of hookup wire to its lugs for connection to the PCB pins. Then you should be ready for the completed PCB assembly, which can be fitted with four 10mm-long tapped insulated spacers, and mounted via these in the case.

With the board in place you can make the connections to it, cutting the transformer secondary leads to about 80mm long before soldering them to the three adjacent terminal pins, and soldering the wires from SW1 to the remaining two pins.

The mains wiring can also be fitted to the various screw terminals along the rear, taking care to fit the mains cord and transformer primary leads to the pair of blocks on the left, and the output sockets to those on the right. Note that in each case, the terminals in each block only carry one side of the mains: active or neutral. Don't connect both brown (active) and blue (neutral) wires to adjacent terminals of the same block, or there'll be an expensive and dangerous 'big bang' when you apply the power!

The final assembly step is to fit a few nylon cable ties to the off-board wiring, to ensure that individual wires can't 'wander' and cause disaster by touching others if a solder joint or screw terminal connection should come loose. As you can see from the internal photo I fitted one to the transformer secondary leads, just up from the PCB terminals, and another around the active and neutral wires to mains socket J1.

(Continued on page 91)



Parts list

Resistors

All 0.25W 5% unless noted:

R1,3	680 ohms
R2,4,14,18	470 ohms
R5	100k
R6	4.7k
R7	22k
R8,9,10, 11,12,13, 15,16,17	10k
R19,20	1k
RV1,2	5k trimpot, horizontal 5mm

Capacitors

C1,2	10nF 275V AC (X class)
C3,4	47nF 275V AC (X Class)
C5	2200uF 25VW RB electro
C6	2.2uF 16VW solid tantalum
C7	4.7uF 16VW solid tantalum
C8	10nF MKT
C9	100uF 16VW RB electro
C10	0.1uF monolithic

Semiconductors

U1	555 timer
U2	4024 CMOS decade counter
U3,4	MOC 3021 optical triac trigger
U5	7812 +12V regulator
Q1-4	BC558 or similar PNP
Q5,6	BC548 or similar NPN
TR1,2	BTA12/600B or similar triac
LED1,2	5mm red LED
D1-4	1N4001 or similar power diode
D5,6	1N914 or 1N4148 signal diode

Miscellaneous

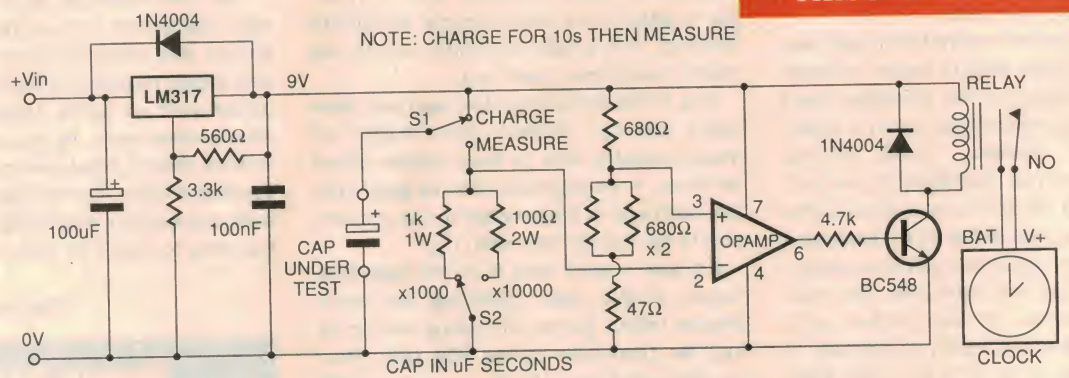
L1,2	Toroidal EMI choke (see text)
SW1	Miniature SPST toggle switch

Plastic utility case. 196 x 113 x 64mm (UB2); PC board, 101 x 90mm (code 99XLB12); 240V to 12.6V CT/150mA power transformer; 4 x 2-way PCB mounting (5mm spaced) screw terminal blocks; 5 x PCB terminal pins; 2 x 3-pin mains sockets, surface mounting; 4 x 10mm insulating spacers with M3 screws and lockwashers; mains cord and 3-pin plug; 5 x 12mm M3 machine screws with 5 x M3 nuts and lockwashers; 2 x 12mm M4 machine screws with 4 x M4 nuts and lockwashers; 16mm grommet for mains cord; 8mm nylon cable clamp; solder lug; 4 x rubber feet; short lengths of mains-insulated wire (brown/blue/yellow-green); hookup wire, solder etc.

Circuit & Design Ideas

Interesting original circuit ideas and design tips from readers. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

THIS MONTH'S WINNER!



Measuring high value capacitors

I use recovered capacitors in building some of my experiments and find the 'ESR and low ohm meter' from EA Jan '96 extremely valuable. I have a digital capacitance meter which measures up to 20,000uF, but recently while building a 300W inverter I was confronted with capacitors far in excess of this top limit.

So, using the discharge curve formula of a capacitor-resistance combination $E = V e^{-t/RC}$ I charged the unknown capacitor with a 9V battery, then discharged it via a 1k load while measuring the capacitor's terminal voltage with a digital multimeter. I then noted the time taken for it to fall to a third of the 9 volt source (3 volts) and calculated capacitance value.

From this tedious exercise, I designed the following circuit which uses a quartz analogue alarm clock from the '$2' shop. The clock works from a 1.5V battery, is self starting, and when set to 12 o'clock can measure time elapsed. By selecting a drop of 0.368 of the original charging voltage and using 1k load, I calculate that capacitance equals time in seconds x 1000uF — alternatively, using a 100 ohm load would give capacitance in seconds x 10,000uF.

The system uses a plug pack giving say 12V DC feeding a 317-type regulator to produce a 9V regulated source, a switch to charge and discharge the capacitor, a comparator (any opamp should do) and a small relay to connect the battery in the clock.

Victor Erdstein
Highett, Vic **$25**

Parallel port interface

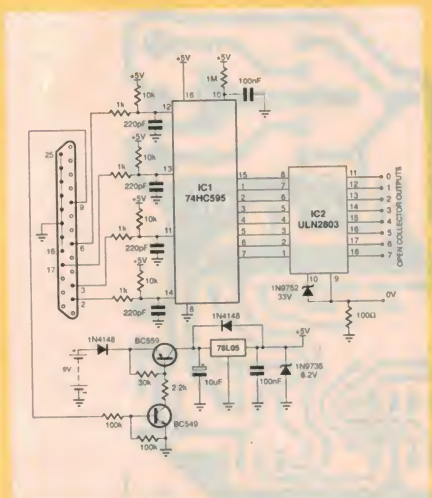
This parallel port interface can toggle 8 outputs at once, and can be controlled by the computer with a simple Qbasic program.

It uses the PC's parallel port to deliver serial data to the 74HC595 serial-in/parallel-out shift register at pin 14, while the remaining printer lines control the output enable (at pin 13) and supply clock signals for the shift and storage registers (pins 11 and 12, respectively).

IC1's parallel outputs are buffered by IC2, a ULN2803 darlington driver, while Pin 9 on the port can shut down the 5V supply (and therefore all the outputs) via the BC559 and BC549 controlling transistors

The Qbasic listing shown here is also available on the EA website in the 'Free downloads' area, so those with web access can avoid potential transcription errors.

Ben Mennessy
Paralowie, SA **$30**




```
CLS
base0 = &H378
OUT base0, &H80: OUT base0 + 2, 11
FOR N = 0 TO 7
Dout(N) = 0
NEXT N
Dout = 0
start:
CLS
INPUT "which output do you want to
toggle"; N
IF N OR N > 7 THEN GOTO start
N = FIX(N)
Dout(N) = ABS(NOT (N))
FOR N = 0 TO 7
IF Dout(N) = 0 THEN
Dout = Dout AND NOT (2 ^ N)
ELSE
Dout = Dout OR 2 ^ N
END IF
NEXT N
FOR bit = 1 TO 8
b = 8 - bit
byte = ((Dout AND 2 ^ b) / 2 ^ b) OR
&H80
OUT base0, byte
OUT base0, byte OR 2
OUT base0, byte
NEXT bit
FOR bit = 9 TO 24
OUT base0, &H82
OUT base0, &H80
NEXT bit
OUT base0, &H90
OUT base0, &H80
GOTO start
```

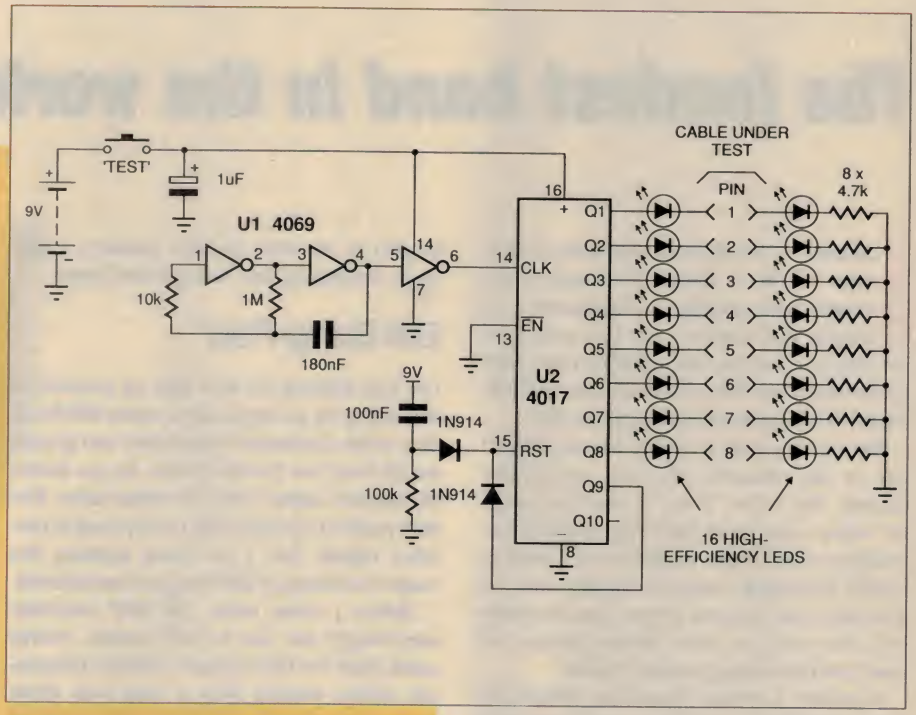
WIN OUR 'IDEA OF THE MONTH' PRIZE!

As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual fee. The prize is a Video Inspection Capture System from Allthings Sales & Services, which consists of a colour CCD camera, close-up lens set, adjustable stand and lamp, PCI video capture card and software, plus video cable and two plugpacks. You can find out more about this great system at the Allthings website; www.allthings.com.au.

Valued at $469!

Win our 'IDEA OF THE MONTH' Prize!

LAN cable tester



I received my October '99 copy of EA and, as usual, read it from cover to cover. What particularly caught my eye, though, was the Product Review of the LAN Cable tester on page 96.

Readers may be interested in a device that I built to test LAN cables, in my capacity of Lab Supervisor for my employer. I need to be able to quickly check many types of cables including the LAN types, and I came up with the simple circuit shown here. It does no more than the reviewed device, but can be built for very low cost. I built mine in the smallest available jiffy box and it has proved invaluable.

The tester is very simple, being comprised of two easily obtainable CMOS chips. Referring to the circuit, U1 (a 4069) is connected as a free running oscillator with a period of about 400ms which drives a 4017 decade counter. The outputs of the counter are connected to the LAN cable under test via series LEDs (low current, high efficiency types).

When the 'test' button is pressed, power is applied to the circuit and the 4017 counter is reset by the 100nF capacitor. The oscillator starts and cycles the counter through each of its eight steps. As each output is connected to the cable lines, the LED associated with each pin should light up. If a short is found, then 2 adjacent LEDs will light. If the cable is not connected 'one to one' then the LEDs will light up to show which pins of the cable are in fact connected.

The cycles repeats for as long as the test button is held down. Typical current drain is about 6mA, so a small 9 volt battery can be used.

Glenn Percy
(via email) **$25**

Fitting modular telephone plugs

If you have ever needed to fit or replace the RJ11 or RJ12 US modular telephone plugs without the aid of the special modular fitting tool, you will appreciate how difficult, if not impossible it can be. Considerable pressure is required to drive home the tiny cable piercing contacts, which invariably leave the gold-plated contacts damaged, rendering the new plug useless.

This is a method to manually fit the plugs without the need of the expensive tool, and is suitable for that occasional repair.

The secret is to remove the contacts from the new modular plug and apply silicon grease to the inside contact slots on the plug body — then with tweezers refit the contacts, fit a four or six conductor cable to the plug, and with a wide blade screwdriver gently press home the cable piercing contacts.

Do not forget to remove all trace of grease from the plug contacting surface to prevent possible dust contamination.

I have used this method to make-up several modular telephone cable sets, with excellent results.

Garry Young
LISMORE **$20** ❖

MOFFAT'S MADHOUSE

The loudest band in the world?

Seattle — the land of Microsoft millionaires — is in boom times right now. Wages are sky-high, unemployment is almost non-existent, and you even hear commercials on the radio offering tasty sign-up bonuses and full benefits for people willing to sling hamburgers at MacDonalds.

But on this side of Puget Sound where I live at the moment, jobs are very scarce indeed. Pay is low, close to minimum wage for many, and most jobs are part-time so employers don't have to pay benefits such as health insurance. Government jobs are an exception, but they are always filled and they stay that way for what seems forever. At least until somebody retires or dies.

It sounds a lot like Tasmania, doesn't it? A low standard of living in the traditional sense, but your reward is living in a place where the land is pretty and the people are sane. Which is why I'm over here on the Olympic Peninsula, scrapping for every dollar in a motley collection of part-time jobs. No big smoke for me!

The main job at the moment is with the local community TV station. But that's a contract job which expires at the end of the year and may well disappear now that the station is up and running. I'm still going around fixing computers, and of course this EA writing gig continues, now into its 19th year by my calculation.

As I've mentioned before in this column, I've been involved with audio engineering work (big name for a sound guy) for quite a while, using other people's rented equipment. But a few months ago I decided to take the plunge, spending over $2000 on my own sound system so I can keep the equipment rental money instead of seeing it go elsewhere.

It's pretty good stuff, mostly of Mackie and JBL manufacture. The mixer in particular is designed for stage production work as well as bands — it has four high-level stereo inputs for things like CD and cassette players, radio mics, and my trusty laptop computer.

Understandably I don't want to bust this stuff, but sometimes there is pressure on you to push the envelope a bit. So far I have resisted this by reverting to other people's equipment, leaving my own safely stored away.

Biff-Bang-Pow

I've just finished my first year as permanent sound guy for an organization called Biff-Bang-Pow which promotes heavy-metal and grunge bands from the Seattle scene. As you probably suspect, being a man of mature years, this isn't really to my taste. But I do try hard to convince myself that I am really enjoying the music I'm mixing at BBP concerts and dances.

Before I came along, the BBP promoter had bought his own sound system, mostly used stuff. He had an older Mackie 16-channel mixer, feeding into a very nice Crest power amp, which in turn fed into a pair of column speakers of unknown parentage, each containing four 12-inch speakers. These in turn were topped by a pair of add-on high frequency horns which were blown long before I started working with the system. But we always installed them regardless because they looked so impressive.

During the first concert I worked with Biff-Bang-Pow, the promoter kept yelling "Louder, louder" until I managed to blow every fuse in the American Legion Hall (same as RSL in Oz). That power amp could certainly draw some amps. The Legion's electrical guy fixed the problem before the next BBP concert by replacing the fuses with three-inch nails.

Every BBP concert or dance seemed to have noisier bands than the previous concert. Eventually the column speakers couldn't take it anymore and one of the 12-inch drivers went west, leaving that column speaker with three. Actually there were only two working because the four were wired in series-parallel.

The promoter said "Don't worry, I'll fix it", and so it was that the speakers returned for the next gig, all repaired. Sort of. The promoter had borrowed a 12-inch speaker from somewhere and installed it in place of the blown one, which was sent off to be refurbished. During reinstallation he managed to get all four of them, three old and one new, hooked up in parallel and out of phase. And the new speaker was 4 ohms, while the old ones were 8 ohms.

Needless to say, when we fired up the system, the repaired column speaker sounded awful compared to its mate on the other side of the stage. The promoter had no idea how he'd wired them, other than swapping leads around until he got some sound out of something. So it was time for investigative surgery.

The coffin

By now there were a few band members hanging around, concerned that the compromised audio system might not be up to reproducing their sweet sounds with sufficient intensity. So we placed a pair of chairs out on the dance floor, facing each other, and laid the column speaker on its back suspended between the chairs.

The column speaker was painted flat black. It looked like a big black coffin lying there on those chairs with its lid open. And the band members, the mourners, strode around staring into the coffin, concerned looks on their faces. I was kneeling by the coffin, hands inside, pulling and prodding wires and saying, "What the hell is this?".

The speaker wires didn't run directly; instead they were stapled into the inside of the box, various pretty colours going hither and yon. I didn't have a multimeter with me (although I think I'll start carrying one now) so we managed to scrounge an AA penlight cell from a guitar player's effects unit. It was now possible to connect the battery to two of the wires and figure out which speaker cone moved in which direction.

In the heat of the moment, with band guys hanging all around, it's hard to get your mind around a screwball electrical layout within a speaker cabinet which had been modified by somebody with no idea of what an ohm is. I kept losing it, and the band guys kept getting more concerned, until I got a brilliant idea: why not draw it out on paper? (Geezzzz...) And then

we knew we had interesting parallel-impedence-mismatch-out-of-phase situation. And to make matters worse, it looked like another one of the original speakers was kaput.

What to do with this mess? Another drawing produced the solution: Hook the two still-working 8-ohm speakers in parallel to make 4 ohms, and then hook that pair in series with the new 4-ohm speaker to make 8 ohms. Here we'd still have only three speakers and there would be a power-sharing imbalance, but at least we'd get some sound out of them.

Up and running, front screwed on, and everything working, more or less. My usual practice is to mix bands in stereo, but since there was no way to get decent balance with one good and one weak speaker, we went for mono with the power to the weak speaker reduced. So there was more power from the left than from the right of the stage. We'd just have to live with it, but at least the bands had a working sound system.

The gig starts

First band up is not a band at all but a guy with a twelve-string guitar. Two mics — one for the singer and one for the guitar — and the sound wasn't half bad. Maybe we'd get away with it, even with most of the sound coming from one side.

The next two bands increased in intensity and jumped around onstage to ever greater heights. This was an interesting exercise in seeing how many knots you could tie in the mic cables by crossing back and forth across your friend's cable, going around behind him, etc. Different people ended up with mics that weren't the ones they started with, so levels were a little messy. But nobody seemed to care as they gyrated in the mosh pit at the foot of the stage.

Band four. Can't remember their name, which is probably good — less chance of lawsuit. As they were setting up, I was doing my usual thing, shuffling microphones around to various instruments and singers. The previous bands had scrambled up the cords, and we hadn't got around to labelling them earlier because of the speaker panic. So I had no idea which mic went to which channel on the mixer.

Then the lead guitar guy came up and said, "You know, you really won't need those. Only one for the singer." Well I wasn't one to mix bands using only one microphone, so I set up the others as well, on two guitar amps and the drum set. Then I left them with it and retreated to my mixer to try to figure out what was what.

First song: BWANGGGG! The room shook as they hit the first guitar chord. And everything on the sound mixer that could light up red, did. And that jury-rigged column speaker seemed to draw back in fright. Then the singer started, or it looked like he did. You could see his jaw flapping but no sound was coming through the system.

I started pulling faders down and the red lights started going away, but the noise from the stage continued unabated. That band was swamping the PA with the extreme sound pressure from their own guitar amps. BWANGGGGGG! Soon members of the audience started coming up to me: "I can g-g-g-er!". "WHAAT??" "I can't understand the singer! Turn him up!" So I had to try to find the singer.

This was a first! Never in my humble audio-mixing experience have I ever heard of a kid who thought a band was TOO LOUD

Mackie sound mixers have a nice feature where you can go along through your mics and isolate each channel into a pair of headphones, while the main mix goes on undisturbed. So I worked my way along, and each channel I heard going BWAANGGG got turned right down. Finally I found the singer's mic, with a strong undercurrent of BWANGs. But I could hear him fine in my headphones as sang his words: "YA-DA-GA-NA-RUMPH! NA-DA-SEE-GEE-GO! AH-AH-SHEE-DE- HUMPF! MY F..." and then erupted a string of rhyming profanity.

Too loud?

Now I understood why nobody could understand the singer. He was singing rubbish. I guess he knew nobody would hear him over the band, so why bother with words? Anyhow, I goosed him up a bit to try to overcome the blasts coming directly from the stage. And finally you could hear the singer coming through the speakers, or at least one of them. The band must have heard the singer through their foldbacks too, and they turned up the guitars all the louder.

We were getting on the verge of escalating nuclear war here. And as I looked around I saw two security guards with their hands over their ears. There were a couple of mothers waiting to pick up their kids, fingers plunged into the sides of their heads. And out on the dance floor, KIDS with hands over their ears. This was a first! Never in my humble audio-mixing experience have I ever heard of a kid who thought a band was TOO LOUD.

As for me, I don't believe in wearing ear production when doing heavy metal bands because I feel it's only fair to experience the sound level the kids are experiencing — then I know when to back off. But this time I kept my headphones in place. They have big bouffy ear cushions and do a fine job keeping out external sounds.

At one stage I did take off the phones to go up to the stage to check on the power amp to see if it was getting too hot. When it does, it shuts down, bringing howls of rage from the audience. What I found was one completely dead column speaker. It fought a good fight, but I guess I just asked too much of it. It looks like the promoter is going to have to replace those old column speakers with something capable of handling the full output of his main amp. Or get a smaller main amp. No, that wouldn't work, we couldn't deafen anybody...

End of the world...

And now, dear readers, it is time to wish all of you a great holiday season and especially a really fun Y2K. And I still say it's plenty of hype and little substance. At the magic hour I'd hoped to be up in an airplane somewhere, just to tweak my nose at fate instead of falling out of the sky.

But now it appears I'll be working, doing sound for a big New Year's Eve stage production at — where else? — the American Legion Hall. A local performance artist has been running excellent comedy revues in a cabaret setting all year, and now he wants to branch out to a large hall, with dinner, drinks, and the stage show as the climax. And exactly at midnight, maybe I can give the sound system one good push and blow all the fuses again... Darkness... end of the world... the millennium arrives...

Would I do that? Maybe... it is indeed tempting... HAPPY NEW BZZZTT!! *%SPUTT— Fizz... Gotcha! ❖

OPEN Fist

BY STEWART FIST

6000 Studies

One of the most disconcerting features of the cellphone-health controversy is that, on one side, you have crisis-mongering activists running around saying "The Sky is Falling", when clearly it isn't. And on the other, you've got a very, very wealthy industry using tobacco-tactics — disinformation, distortion of research, and well-funded political lobbying. This is led by Motorola in the USA, and Nokia in Europe, but the industry associations are also directly involved.

The industry has a worldwide trouble-shooting-and-propaganda operation run by the American Cellular Telephone Industry Association (CTIA) using local associations like the Australian Mobile Telecommunications Association (ATMA). Together they employ the world's largest public relations companies (primarily Burson-Marsteller, but also others) to spread their message of confidence and certainty.

One of their most ridiculous claims is that there are "6000 scientific research reports that prove the safety of cellular phones." Sometimes, when they are in a euphoric mood at conferences, the numbers jump to 20,000 reports, but 6000 is a good mean average.

Over the last few decades I've asked the industry representatives to supply me with a list of these 6000 scientific research reports so that I can hang them on my wall and marvel at them. You see, one of the fundamentals of research is that you can't prove a negative like this, only positives. I doubt that anyone can even prove that water "is safe".

Even allowing for poetic license and assuming that they really just claim: "6000 research reports found no evidence of damage from cellular phones," (ignoring the time-scale or the relevance) I'd be interested to see which reports are included.

One of their most ridiculous claims is that there are "6000 scientific research reports that prove the safety of cellular phones."

Suppose, as a scientist, I use as my hypothesis that; "Cellphone radiations can cause heating of the ear". If I then took twenty students, made them talk for ten minutes on their mobile phone, measured ear temperatures and found no significant difference, would this then research report then become No.6001 proving cellphones to be safe?

If you are a die-hard member of the industry: Of course it would. If instead, you are an average intelligent human being: Of course it does not. It doesn't even prove that ears won't be hot after twenty minutes.

Modified request

In recent years I've modified my request for information from the ATMA. First I began to ask for a standard reference list to be posted of only the 600 most important findings which, in their opinion, established safety. Later I downsized my request to 60.

Then later again, I made what I thought was a reasonable request for just six. Bingo!

They didn't actually send me anything, but they did publish a pamphlet listing the half-dozen key research reports supporting their case. And, at the AMTA web-site **http://www.amta.org.au/issues/faq.htm**, they put up four examples, which were listed as: "among the greatest relevance to the issue of possible human health effects of radiowaves."

Later three of these four were scrapped (the second was decidedly dodgy, and two others were unknown) and the following four were put up as the key "international studies that have examined cancer and mortality in rodents exposed to radio signals in the frequency range used by mobile phones." You'll find this at **www.amta.org.au/issues/animals.htm:**

Brain tumor incidence in rats chronically exposed to digital cellular telephone fields in an initiation-promotion model: W.R. Adey, et al.(USA) 1996: *"837 MHz Pulsed wave exposure of rats found no evidence of brain tumor initiation or promotion. A non-significant tumor-inhibitive effect was observed."*

Growth of chemical induced tumors in rats: B. Veyret, et al. (France) 1996. *"900 MHz pulsed wave exposure of rats found no evidence of promotion of chemical induced tumors."*

Experimental studies of brain tumor development during exposure to continuous and pulsed 915 MHz radio frequency radiation: L.G. Salford, et al. (Sweden) 1993. *"915 MHz continuous and pulsed wave exposure of rats found no evidence of brain tumor promotion."*

Effects of 800 MHz electromagnetic radiation on body weight, activity, haematopoiesis and life span in mice: J.F. Spalding, et al. (USA) 1970. *"800 MHz continuous wave exposure of mice found no detrimental health effects."*

There are a couple of points of interest here. All four of the scientists quoted have published reports showing that RF *does* adversely effect cell tissue, so this is a case of selective incidence.

In 1992 and 1997 Salford established convincingly that GSM handset exposure changed the permeability of the blood-brain barrier (which stops aggressive blood cells from permeating brain tissue). In 1991, Veyret found an elevation of antibody-producing cells in the immune system of mice after very low exposure levels. And in 1971, Spalding was one of the first to find raised levels of cancers in exposed rats — albeit, below a levels of scientific significance.

However all three of the AMTA's publications put Dr Ross Adey's rat-brain/tumour study at their head of their lists, and Adey is probably the best known and most widely published and quoted researcher on this subject in the world. He has certainly been involved in EMF- and RF-health research longer than any other scientist today, and he is well known as a fierce promoter of very much lower exposures standards.

Paul Ransley, a reporter on the Channel 9's *Business Sunday* program, asked me to comment on-camera about the AMTA's claims of scientific support, so I wrote to Adey, and he e-mailed back directly to Paul Ransley, with a carbon copy to me (giving permission for publication):

It has come to my notice that the Australian cellphone industry has singled out one of our studies to support their claim that cellphones are safe.

Nothing could be farther from the truth. My research team has published hundreds of papers on this subject over the past 35 years, many with disturbing findings.

From this pioneering research, it is my considered view that there is unequivocal laboratory and epidemiological evidence pointing to potentially adverse health effects of radio frequency and microwave radiation. Nothing in our research findings can be construed as supporting the view that use of a cellphone is free from health risks.

To the contrary, our research in animal models exposed to digital cellphone fields has revealed the occurrence of effects on regulation of cell growth related to tumour formation. Extreme caution is necessary before directly extrapolating these findings to human health risks.

Reduced tumour numbers in exposed animals seen in one of our experiments as opposed to an increase, is of vastly less significance in a medical context than the finding that there was a field effect on cell growth regulation. It will be some months before these findings finally appear in an international peer-reviewed journal.

But with a feckless irresponsibility so characteristic of their venal vested interests, industry organisations have hastily concluded that our findings support their endless chant, indeed their mantra, that use of these phones carries no risk.

And from the biomedical research of which they have been virtually the sole sponsors worldwide, they openly state that the only answer that they wish to hear is one unequivocally supporting corporate positions and policies, totally unfettered by health concerns.

W. Ross Adey

So I have to conclude that the AMTA's top list of 6000 research reports which prove cellphones to be safe, turns out not to be quite as supportive as they claimed.

In case you detected a nuance of ocker bluntness in Ross Adey's reply, I should point out that he was born in Adelaide, although he has spent the last forty years at the very top of American biological research institutions. Currently he is a Professor of Biochemistry at the University of California, Riverside.

Adey has probably published 300 or so papers on possible radiation effects at the biological cell level, and his interest is not so much in cellphones as in understanding how human and animal cells develop and communicate with each other using ionic flows and electrical messaging.

But even when taken in isolation, as the AMTA tried to do, this study *does* confirm that RF can have a direct effect on tissue - which is the primary factor denied by the cellphone industry.

In this regard, none of the AMTA's three lists mentioned the most famous study of all (probably the second most quoted of all time); the Royal Adelaide Hospital mouse study, which found 2.4-times the lymphoma rate in a hundred lab mice after only 18 months of GSM-handset exposure.

I'm amazed that they forgot to include this one, since the study was funded by three of AMTA's key members (Telstra, Optus and Vodafone) and it was set up and run by their favourite scientist, Dr Michael Repacholi, who has previously given evidence promoting the safety of cellphones in court cases against base-stations and towers.

Repacholi's later Adelaide Hospital findings are now quoted around the world as evidence that cellphone levels of non-ionising radiation can create changes in animal tissue. And since lymphoma is a disease of DNA (and DNA is DNA, whether in mice or men) this is obviously a serious matter.

It's just a pity that the industry doesn't come out of its obsessive state of denial and start to do something about engineering to reduce the potential for problems.❖

Forum

Conducted by Jim Rowe

Firms that won't supply service info, and a gripe about sped-up movies on DVD...

This month, we look at an ongoing problem that's been plaguing the electronics industry for many years, without any real solution emerging. We also look at some drawbacks with DVD movies released in Australia — the conversion to PAL sacrifices sound and picture quality, and it seems that the manufacturers just don't want to know...

WAY BACK IN the mid 1960s, not long after I had been appointed Editor of this venerable magazine, I wrote an article complaining about the difficulty experienced by both professional and amateur service people — and also consumers — in obtaining circuits and other helpful servicing information for electronic equipment. I pointed out that this information was often virtually essential for efficient servicing and correct adjustment of equipment, and suggested that as a result there was at least a moral obligation on manufacturers to make it available to both owners and service personnel.

As I recall, the article drew quite a strong response, almost evenly divided between two different groups. On one hand there were angry letters from local consumer equipment manufacturers (there were still a few, then), calling me a fool and seeking to justify their unwillingness to supply such information; on the other hand there were somewhat happier letters from readers, basically saying "Yeah — put the boot in! We've got a right to this information, so we can make sure our equipment is looked after properly!"

Well, that was the mid 1960s, and things have probably improved a bit in the last 33 or so years. But not as much as we might have hoped, because some manufacturers are pretty clearly still fighting tooth and nail to avoid providing servicing information either at all, or to anyone other than their own designated service agents — despite our now having consumer protection and restrictive trade practice legislation. Our first two contributions this month make this pretty clear...

The first item is from engineer Peter Churchill, of Kambah in the ACT, who really brought back memories for me with his title 'Field Service Information and the Right to Fix one's own Appliances'. Here's what Mr Churchill wrote:

I am not sure whether this story is best suited to 'Forum' or 'Serviceman', should you choose to use it, as it touches on a subject that has appeared from time to time ever

since electronic appliances have been marketed. The nub of the issue is refusal of a supplier to provide service information.

I am a qualified electronics engineer and before that, a technician with appropriate formal training, and I am in the habit of effecting my own repairs to household items in need of such. I hold current ACT and NSW electrician's licences, having entered the workforce by way of an apprentice electrical fitter more years ago than I care to admit.

My wife has a Breville model BB200 Breadmaker, that after two year's service has developed symptoms that indicate a dry joint, solder or otherwise, somewhere in its intestines. Ho, ho, thinks I, an easy one! One Saturday morning I proceeded to dismantle the offending beast, by removing the securing screws around the bottom of the cover. It was at this stage that my best intentions hit the proverbial brick wall.

Having removed all the visible screws, I discovered that the cover was still locked to the bottom panel by some internal fasteners along the bottom front. Upending the unit revealed two plastic inserts that fit into two square-section holes moulded in the base. A third moulded hole contained no insert. After an hour of frustration, I could see no method of removing these inserts without damaging them, or perhaps even the cover. I was, of course, assuming that these inserts played a part in holding the cover to the base.

OK, I thought, there is some cunning trick to removing the cover, so I will contact the suppliers and organise a set of field service documents. On calling the suppliers, I was informed that they would not provide any service documentation and that I would have to take the appliance to an 'authorised' service centre.

Not to be deterred at this stage, I called Consumer Affairs to get their opinion of the situation. I was advised that the supplier's refusal may contravene the 'third party forcing' provisions of the relevant legislation. I therefore decided to write a letter to the supplier, seeking their point of view.

In due course, a response arrived advising me that it was their (international) supplier's policy not to provide his (sic) intellectual property to a third party. The local supplier, then, was claiming that its 'hands were tied'.

A convenient cop-out? Perhaps. A subsequent call to Consumer Affairs indicated that I was stymied, as the third party forcing provisions applied to restrictions imposed by a supplier at the time of sale, and I had freely chosen this particular product for purchase. It was only after a fault developed that any 'restrictions' came to light.

What to do? I am faced with either taking the breadmaker to the authorised service centre and paying, I am sure, a not inconsiderable sum to carry out a repair that I am quite capable of performing myself, or perhaps ditching the whole thing and buying a (different brand!) breadmaker. The second option would at least enable me to wreak violence upon the device and discover just how the cover is fastened at the bottom front.

Now, I recognise that I could incur the collective wrath of the appliance service industry for my attitude in this matter. We all have to make a living, and I have read all the discussion in recent issues of EA regarding the great difficulty, or even worth, of entering the service industry. I would say that as a 'free citizen', I reserve the right to effect my own repairs to my own property, in those areas in which I have expertise.

However I cannot help but wonder whether the cover fastenings have been specifically designed to prevent anyone other than an 'authorised service centre' from gaining access to the interior. Do we have a product here that, not so much has been designed without the serviceman in mind (how many times have I read that phrase in the 'Serviceman' column?), but has been designed to specifically exclude service by other than those of the supplier's choosing?

Have readers come across this type of situation, with other appliances? I have seen other appliances where every screw except one was a Phillips head, with the remaining one a Torx head. This ruse no longer works, as Torx drivers are readily available.

I believe the breadmaker has a relatively simple interior, with little more than a relay or two to operate the mixer motor and heater and a microprocessor to control the lot. I am not interested in the firmware content of the microcontroller or its actual external circuitry, so the original supplier is welcome to his intellectual property in that regard. I just want to know how to get the bl**dy cover off, without destroying it!

What do other readers think? And — Er, does anyone know how to remove the cover of a Breville model BB200 breadmaker?

Thanks for that very interesting story, Peter. It certainly illustrates that the problem of manufacturers witholding service information is still very much alive and well as we end this decade and century, despite all of the much-touted Consumer Affairs and Trade Practices legislation that nowadays supposedly protects the rights of we consumers.

In fact I don't know about you, but that business of the local supplier being able to quote their own international supplier's policy as a cop-out, coupled with the legal nit-picking about whether the restrictions were imposed at the time of sale or later on, suggest to me that the Consumer Affairs legislation has enough loopholes in this area to render it totally ineffective.

And as for that claim that the manufacturer has a policy of not providing their intellectual property to a third party, what a lot of bunkum! Any competitor who seriously wanted to analyse or copy any intellectual property involved in the product would simply buy a couple, break them apart if necessary and use the well-established techniques of 'reverse engineering'.

Frankly, I don't have any doubt that the real reason for refusing to supply the service information in this kind of a situation is purely a desire to force customers to have the equipment serviced by the 'authorised service centre' — i.e., to give that centre an effective monopoly with respect to servicing the products concerned.

It will be interesting to see what other readers think, Peter, but like you I certainly believe that as citizens and legitimate purchasers of equipment we have (or should have) the right to effect our own repairs to that equipment, and/or to have it serviced by whomever we wish. And to allow us to exercise that right, we should have a legal right to demand and be supplied with all technical information necessary to service it effectively and efficiently.

By the way, I really tend to baulk at that term 'authorised service centre', because to me all it really means is that the manufacturer or supplier has unilaterally decided to restrict the rights of consumers buying their products, when it comes to getting them serviced. The reality is, of course, that such service centres are 'authorised' solely by the supplier — without so much as a 'do you mind?' to the consumer.

This kind of thing has been going on for years, and nothing ever seems to have been done about it. I guess it shows that in reality, the rights of the consumer are given much lower priority than the rights of the manufacturer and supplier to maximise their profits.

It's surely avoiding the issue to claim that consumers can always buy a different product if they don't agree with the restrictive service arrangements of a particular manufacturer or

'Sped-up' movies

Let's move on to consider something we haven't looked at for some time: the supposedly 'minor' adjustments to the frame/field rate of movies when they're transferred to video and supplied on media like videotape or DVD. It's a subject that the suppliers of movie software on these video media would no doubt prefer us not to think about, but it's also one that EA's readers should probably be aware of, with the release of movies on DVD finally getting under weigh here.

Fortunately I've received an e-mail which explains nicely what this is all about, so there's no need for much preamble from me. The main thing to bear in mind is that the situation arises because movies are basically shot on film at 24 frames per second, and projected at the same rate when you see them at the cinema. But when they're transferred to video, they have to be 'massaged' in one way or another because video formats have traditionally used a different frame/field rate: 50 fields/second (i.e., 25 frames/sec) for our PAL system, or 60 fields/second (30 frames/sec) for the NTSC system. It's the specific techniques used to achieve this transfer that can lead to arguments...

OK; with that quick introduction, here's the e-mail that prompted this renewed look at the subject. It comes from Melbourne reader Kevin Attwood, and as you'll see it brings the discussion very much into relevance for today's DVD and digital video era:

I have owned a DVD machine since October 1997 and order DVDs from the USA regularly. I have a REAL problem with PAL disks that in this day and age, in my opinion, should have been fixed when DVD was developed.

When I started buying NTSC DVDs from the US I noticed that the movie times on the DVD's were approximately 4% longer than the same PAL movie. My investigations over a time found that movies are in fact 'sped up' from 24 to 25 frames/second when transferring to PAL. The NTSC markets use the 3/2 pulldown method, which adds six extra frames to the 24 movie frames, totalling 30 frames per second. As a result the NTSC movie is released on video running at the movie speed, while the PAL version is 4% faster!

This would not be so annoying if the manufacturers time-compressed the audio, with no pitch shift. Alas, they take the easy way out and we're left listening to sonically pitched up sound.

I have tried to take this up with the manufacturers, who basically don't want to know about it. I've learnt that PAL movies have always been sped up, and that the DVD itself does the conversion (unlike a VCR, which has the tape recorded at the higher frame rate). The DVD has the same digital information on it in all regions, but a code is added to tell the player to output at the PAL sped up rate.

I purchased a Pioneer 414s DVD player recently because it plays CD-R. This machine has an option to output NTSC video as PAL, for PAL-only TV's. What a surprise I got when this option played my NTSC discs as PAL, WITHOUT an audible pitch shift! Unlike pseudo-PAL put out from NTSC compatible VCRs, the NTSC>PAL picture on the Pioneer was indistinguishable from the NTSC-only output. In other words I was watching a movie in PAL, at the correct movie speed.

Why then are we being subjected to 4% pitched-up movies, when it is possible to play a movie on a PAL TV at the right speed?

I also did not notice any shudder (the strobing effect that is sometimes evident on fast moving pictures on a converted NTSC to PAL picture). I buy DVD for the purity of the picture and sound. No more tape dropout, wear and tape stretching, FM sound etc., for me.

I find the pitched up audio unbearable on movies with musical soundtracks and I'm annoyed that I can't see a PAL movie at the speed I saw them in the cinema. As a reference, the PAL version of TITANIC runs for 187 minutes while the NTSC version runs for 194.

Looks like I'll be buying from the USA continually!

PS: Some people have argued that the PAL picture, being superior to NTSC, offsets the fact that they have to speed up the movie for transfer to video. I say an NTSC DVD's picture quality is far superior to broadcast and video PAL. The slightly lower picture quality of NTSC DVD compared to PAL DVD is not as noticeable as pitched up sound.

Well, there you are. Thanks for those comments, Kevin, and you've made some excellent points. As you say, the basic problem may have been around for quite a while, but with the development of digital video and DVDs there does seem to have been an excellent opportunity to avoid the need to speed up movies by that significant 4% in the transfer to PAL video.

Why wasn't this done, then? As you say, the fact that your player will play 'NTSC' discs in PAL, and at the correct speed, suggests that it's really not at all hard to do. Have the software suppliers just been lazy, and hoping few people would notice? It will be interesting to see if any of them deign to offer us any explanations.

supplier. That's because (a) how many suppliers make it clear that they have such restrictive practices, at the point of sale? and (b) how easy is it for a consumer, before making a purchase, to find out which other suppliers (if any) DON'T impose such restrictions?

No web info, either

Let's move on, though, and consider our second contribution on the same broad topic, which came as an e-mail from reader and occasional contributor Robert Gott — who hails from Toowoomba in Queensland, if my memory serves me right. Mr Gott brings up another aspect, and one which is very relevant in the current era. Here's what he has to say:

I've read with interest the recent discussions in Forum, relating to the alleged inadequate TAFE training of electronics technicians and whether you need an oscilloscope for servicing. In my humble opinion, as a retired ex-industrial instrumentation fitter, I view the lack of good clear service information to be just as much a culprit as the other factors.

At an early age, as a schoolboy, I taught myself to read circuit diagrams with the aid of the then-ubiquitous Newnes textbooks. Leaving school at 16, I joined the RAF as an Air Radio Fitter (airborne wireless and radar) apprentice, training on Lancasters. Then three years later, I qualified as a Junior Technician. My first posting was to a Canberra bomber squadron at Binbrook, Lincolnshire.

Except in war, in which I was engaged twice, life was fairly unhurried and relaxed. Technical information was rarely a problem, as you can imagine, and at one point I became a technical writer for six months on Bloodhound MK I, a surface-to-air guided weapon.

On discharge, I became a qualified City & Guilds TV tech ('Engineers', we were called!) in Yorkshire. Was I in for a shock! I had to work fast and often without a circuit diagram.

Now this is what a recent correspondent to Forum has stated as a vital pre-requisite for today's electronic technician. I couldn't agree more, but I have to admit, I wouldn't make it today; I'm too slow. It is not just my ageing brain cells; I've always been fairly slow, and to boot, I've never worked well without circuit diagrams and explanations. So we come to my main gripe!

I find it totally inexcuseable that most manufacturers will not provide ANYONE with technical information over the Internet. Many of them now have all-swinging, all dancing (literally in some cases) Web sites. Great if you want to BUY something, but not so great if you want service information. Why not?

The equipment is designed by CAD, often produced by computer robotics, and usually all the info is already there in electronic format. So why the belligerant reluctance to give out the data to anyone who needs it?

Surf the 'Net for semiconductor data, no problem; a downloaded PDF file and specifications, pin outs, circuits; fine. But need a circuit and description or part numbers/prices for any of the following: domestic electronics, consumer white electrical goods, electric scooters, battery chargers, high pressure water cleaners, coffee machines, computer monitors — you must be joking! But why?

It is totally wasteful these days to sell voluminous service manuals, isn't it? So what is wrong with putting the whole whizz bang on the Web site, so it can be browsed, and the required pages (in colour) downloaded?

A block schematic can be of assistance, but today's dedicated LSI chips are so bewildering. My heart goes out to all aspiring technicians.

If one does wrestle a circuit out of a manufacturer or supplier, it will often, as commented on by other contributors, not have any voltages, measurement conditions or critical wiring colours. As for an essential few paragraphs of function explanation — forget it!

I cannot understand why there is such reluctance to explain circuitry. Is there an entrenched "well if you are a tech you should know these things" syndrome?

An example to finalise. A company supplying high pressure water washers consistently hedged at supplying a manual, in English, especially details of a vital expensive electronic sub unit. In desperation, a garage owner asked me if I could fix the washer. It took me weeks to trace and draw out the whole mechanical, electrical and electronic configuration and how they functioned. Not easy with interlocking logic circuitry.

Four weeks later, I had fixed the washer, built a simulator to test and repair the electronic module, written a comprehensive service manual with easy step-by-step explanations, and tabled a faultfinding guide.

Why, you might ask? A professional job would have cost thousands of dollars. I did it basically for free, just to show that manufacturer that some of us will not be beaten at any cost. Per ardua ad astra!

I hope as we enter year 2000 that this service information situation will improve. To hopeful aspiring technicians: don't give up, we do need you. It's going to get a lot more high tech out there.

My plea is that manufacturers give us the tools (good info) to get the job done EASIER. Fortunately, there is a groundswell on the Internet to share esoteric info. The more the better I say! What say you?

Thanks for those comments too, Mr Gott. I'm certainly not seeking to excuse them, but I guess the refusal of equipment manufacturers to make much technical and service information available on the net/web is basically just another aspect of their unwillingness to make it available via ANY means. If you don't really want to make information available, I guess the last medium you'd even consider using to make it available would be the one that would do it most efficiently and effectively, to the widest range of people!

On the other hand, as you suggest the net/web may well turn out to be an agent for achieving real and beneficial change in this thorny area. Complaints by naive magazine editors and 'investigations' by consumer protection and trade practices bodies may not have achieved much, but perhaps the friendly and helpful interchange of information in the net/web's global cybervillage WILL finally weaken the manufacturers' 'conspiracy of silence'. We can always hope, can't we?

By the way, congratulations on all the work you seem to have done to help your local garage owner repair those high pressure water cleaner control modules, in the absence of any help from the manufacturers. That was a great achievement. A question, though: have you made all of that hard-won information available on the net/web, to help others in a similar position around the world? I suspect it will only be as a result of people like yourself making this kind of information available in cyberspace, that the manufacturers' conspiracy of silence *will* be eventually broken. ❖

SERVICEMAN

What's more reliable, the IC or the socket?

This month we look at some tales of woe concerning the more mechanical aspects of modern electronics design. When you are faced with a fault, the usual assumption is that the problem is electrical, but two of our stories this month show that this isn't always the case...

Most stories in these pages come from readers who have at least a smattering of knowledge about servicing and its problems.

Our first story this month comes from a contributor who professes quite the opposite - he knows nothing about how to go about fixing a problem. He is Peter Fox, of Broken Hill in NSW. Peter might not know anything about correcting electronic faults, yet in his story he exhibits all the cunning of one who has been at the job for years. As you'll see, he gets almost right through the tale before tripping himself up by revealing how little he really knows.

Chatterbox

I have read every issue of Electronics Australia since 1972, and can therefore say that I have a good understanding of things electronic, at least from a hobbyist point of view. But confront me with a radio or something that does not work, and I am usually at a loss to know how to proceed.

It was with some pride, then, that recently I succeeded in restoring something to working order. The gadget in question is a computer speech synthesiser, based on a specialised IC called a Votrax SC-01, and configured to work from a Centronics printer port. (It is the version designed by Tom Moffat, called the 'Chatterbox', and published in ETI in January 1985).

In this device, numbers are sent to the port by the computer as if for printing, but instead of representing characters or picture elements, the numbers represent speech sounds (called 'phonemes') and a sequence of them forms a more or less intelligible utterance, when the output is connected to a speaker. (Understanding it takes a bit of practice, rather like listening to the Goon Show).

My Chatterbox worked well in its original setup, connected to a now thoroughly obsolete computer. My troubles began when I decided to rewire the connector to fit an IBM compatible computer. After an initial disappointment was resolved by connecting the 'paper out' line to ground, I managed to get it to say something coherent. I joyfully replaced the circuit board in its box and screwed down the lid, only to find that now it refused to work.

At switch-on, it would produce a continuous sound, like 'aaaah' or 'nnnnn', but no amount of outputting numbers would change the sound. It would respond after a fashion to codes to change the intonation level, but not quite as it should. This state of affairs remained stubbornly true despite all my subsequent efforts to locate the problem.

The project lapsed for a long time, until recently my interest in it was rekindled. I set it up again with a bench power supply and computer and probed it with a multimeter. I reasoned that since the SC-01 worked enough to produce a sound, it was probably OK and that the fault lay elsewhere. At least I hoped so as a replacement would probably be unobtainable now.

The main supply for the SC-01 is 9 to 12V, from which 5V is derived via a 5.8V zener diode to power a couple of logic chips, namely a 4001 quad NOR gate and a 4050 hex buffer. This 5V measured closer to 4V and I wondered if that might be related to the malfunction. Besides this, the voltage disappeared from time to time and would frequently return only when the computer was turned off and on (which was rather a pain!)

I went to see a serviceman whose shop was close by, to ask him (a) if a 5.6V zener that delivered 4V was within tolerance, and (b) if a series 4000 IC would work reliably with such a supply. His response was to give me a new 5.6V zener to try in place of the other. Well, with the new one installed, the supply was still 4V! At this point I suspected the meter (a moving-coil type) and measured the voltage again using a newer meter with a liquid crystal bargraph display and presumably a higher input impedance. This one registered 5.4V which was much better.

I turned my attention then to the logic ICs. The 4050 was used to buffer the six lines that carried the sound codes to the 'phoneme' inputs of the SC-01. Each output line of the 4050 faithfully reproduced its input voltage level and these levels appeared at the corresponding pins of the SC-01, so I gave the 4050 a clean bill of health.

The 4001 was not so easy to test. Two of its four NOR gates were used in the strobe circuit, presumably to lengthen the strobe pulse by a suitable amount so that the SC-01 could sense it. Unfortunately it was difficult to tell if a pulse of less than a microsecond was present or not, using only a multimeter.

The other two NOR gates were wired as inverters and were used in two lines that set four levels of voice pitch for an intonation control. This section worked imperfectly, providing two rather than four, pitch levels. The 5V supply would still disappear sometimes, leading me to wonder if a tantalum capacitor connected across the zener might be intermittently leaky. Or was it the 4001? I just didn't know.

When I reported this to the serviceman, he said that the first thing I should do was to try a new 4001. This I duly did and on switching on I was met by a total absence of the 5V supply. I lifted one end of the zener and discovered that it had objected to all the unsoldering and resoldering I had done and was now open circuit. I reinstalled the original zener and tried again. Thankfully, it was still functioning, and I had a steady 5V again.

In addition, all four intonation levels appeared on cue and now it would sometimes alter the sound to the one specified by the number at the inputs, especially if I tapped the SC-01's strobe pin a few times with a meter probe. This was an improvement, but not enough. It was still well short of producing connected speech.

I wanted to know more about what was happening to the strobe signal and wondered if I could impose on the serviceman's helpfulness again, to get a look at it with an oscilloscope. But before I went that far I thought I would check the continuity of the

strobe line on the circuit board.

It was continuous all right, all the way from pin 3 of the 4001 to pin 7 of the SC-01's socket, but not to pin 7 of the SC-01 itself! Out came the IC, the pins on that side were bent inward slightly with pair of long-nosed pliers, and the chip was replaced. And that did the trick. Full speech capability was restored. My thanks went to the friendly serviceman who put me on the right track.

One puzzle that still remains is that the Chatterbox works when the BIOS printer interrupt (INT 23) is used, but not with the printer service of the DOS interrupt (INT 33, service 5). I suspect I will have to pay attention to some of the other status lines present on the Centronics interface, to make sure their levels are correct.

What had caused the 4001 to fail? I can only suppose that at the last moment, before I put the board in its box, it shorted on some metal object on my desk. If that is what happened, I am lucky that the damage was not worse.

And why pin 7 of the SC-01 should lose contact with its socket after all this time is a mystery to me. Both events seem to be part of the same malfunction, but did they happen together or independently? As for the multimeter, a slight nudge to the zero set screw greatly improved its accuracy.

Now, all I need is another Centronics port on my computer, so that I don't have to unplug the printer when I want the computer to speak to me.

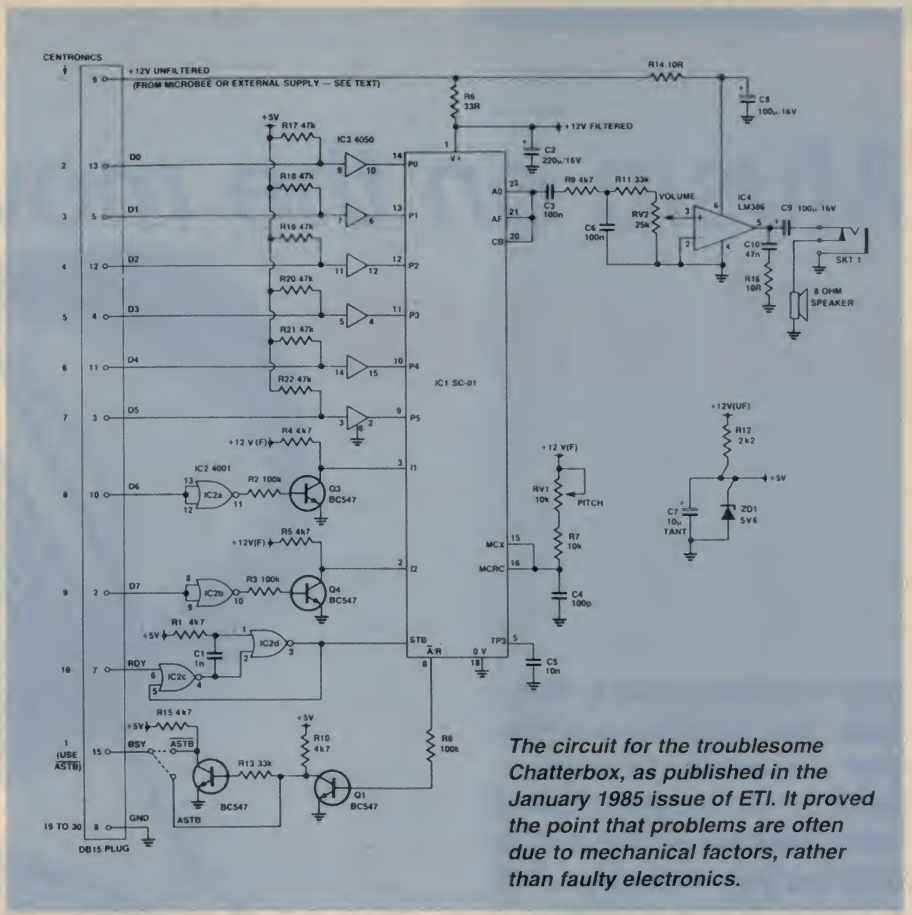
Well, how was that for a repair by someone who "..doesn't know anything"? In some respects it's a job that even I would hesitate to tackle. Working around any digital circuitry without appropriate tools is not conducive to one's mental health. At the very least one needs a logic probe to see what is going on. A logic pulser and an oscilloscope are very desirable extras. So when Peter tackled his Chatterbox with nothing more than a not-too-accurate multimeter, he was hoping for more that I would be prepared to expect.

Unfortunately, Peter gave himself a harder than necessary job by ignoring (or not knowing) that IC sockets are the most unreliable component in any circuit, only just behind electrolytic capacitors as the cause of electronic mayhem. If he had gone straight to the socket when he started work, most likely the rest of the exercise would have been avoided.

In the early days of IC technology, it was felt that the devices may not be reliable, hence the use of sockets to make it easy to replace defective chips. However, most ICs proved to be remarkably robust and it was the sockets that caused trouble. I've lost count of the number of faults I've cured by removing the socket and soldering the IC directly into the PCB.

Sorry I can't help you with the extra Centronics port but what is wrong with a data switch box? I had that problem recently when I needed two serial ports on my computer. Needless to say the box I bought didn't match the plugs on my machine - I had to change a D25 for a D9 but the end result is most satisfactory and I haven't changed a plug in months. The only problem is with me! I repeatedly forget to switch over to the device I want to use...

Thanks for that story Peter. And I think our friend Tom Moffat will be pleased to hear that his old Chatterbox is still chattering away after all these years.



The circuit for the troublesome Chatterbox, as published in the January 1985 issue of ETI. It proved the point that problems are often due to mechanical factors, rather than faulty electronics.

More mechanics

By an odd coincidence, another story has just arrived telling of ICs and their mechanical problems. It comes from Bill Fitzsimons, of Kunyung in Victoria. Bill does not profess ignorance of matters electronic, as Peter does. But he still has a long search before coming to the conclusion that ICs don't fail as often as one might expect. Here's what he has to say....

I've always had electronics as a hobby so fixing equipment for relatives and friends is not new. However,after reading up on CD Player technology, I've realised that they are a lot like PC technology - specialised VLSI chips, not much information for servicing, early obsolescence of components, reducing prices with increased functionality - which often makes them an unprofitable proposition to repair. But there are exceptions and the following story is typical.

It involves a lucky break (you'll see why later) for an old Marantz CD Player belonging to a friend. The symptoms were that the disk motor took off at high speed as soon as the Power button was pressed. 'Play' would initiate an 'All Zeros' display indicating that a disc could not be detected, the 'Open/Close' button activated the tray transport correctly, however the CD's speed was too high to read its Table of Contents.

So between the Play and Open/Close button results and seeing the laser attempt to focus when Play was pressed, it appeared that some basic functions were intact. Therefore it looked to be worth proceeding with.

Not having a circuit, I armed myself with antistatic wrist strap and Torx Driver, then checked power supply lines with a scope, specific transistors on a component tester and a general inspection for dry joints. But I could see nothing obvious. A signal line labeled Vc going to the motor deck measured 5V in the faulty condition but stopped the motor when disconnected. As Vc came directly from the (probably now unavailable) M4804A decoder chip, I wondered if this chip was faulty.

Assuming that the decoder depended to some degree on the microprocessor, I checked for clock pulses, just in case. There were no pulses at the micro. Why? Voltage checks would reveal the answer. 5V was reaching the micro but its earth was at 3V relative to the power supply earth! On very close examination, a microscopic dry joint could be

(Continued on page 91)

Music on the move:
a CD with ESP

Here's something nice to find under your Christmas tree this year — a portable CD player with ESP. No, it doesn't work out which track you want to hear by decoding your brainwaves, ESP is Electronic Skip Protection, and it makes Philips' new player almost unstoppable.

by Graham Cattley

Want music on the move? Portable CD players are one answer, as you get over an hour of perfect sound, and you don't have to mess around dubbing tapes or ripping MP3. The main problem with most portable CD players is that they skip if you move them around — not a good thing considering that they're supposed to be portable. If you have a player with ESP, though, you'll find that skipping is no longer an issue.

The secret is that an ESP-enabled player buffers the music into internal RAM, and this gives the mechanism time to recover from any jolts or bumps it might encounter. The longer the buffer, the more immune the player is to skipping, and a number of players offer between 10 and 30 seconds of ESP. The Philips AZ7883 has perhaps the biggest buffer I've come across, weighing in at 45 seconds playback time. This equates to 2MB of RAM inside the player, making the thing absolutely bulletproof.

You get perfect continuous sound through the headphones, even if you pick it up and shake it. To be honest, we were in danger of inflicting serious damage on the player trying to get it to skip — we just couldn't kill it.

Endearing qualities

The AZ7883 (Yes, that's its official name, despite the fancy logo on the front) has a couple of other endearing qualities, obviously thought up by people who actually use portable CD players, rather than the usual marketing committee...

First among these is the Resume switch, which saves the exact position in the track when you switch off the player. When you next switch on, it picks up from where it left off — handy when you're dealing with constant interruptions.

There's also comprehensive track control, including a programmable track sequence. Up to 99 tracks can be pro-

Ahh, so that's where they hide the batteries... As you can see, the player couldn't really be much smaller, being just 3mm larger than the diameter of a CD.

At far left is the player with its rather flash earphones. Do us a favour though, and use a pair of in-ear style 'phones instead if you are going to listen to the thing on the bus...

Features

Runs on 2 AA batteries
Easily programmable
Scan, Shuffle and Repeat modes
Resume function to continue play between sessions.
Button lock switch
Excellent ESP skip protection
Optional corded remote control
Comes with car kit and AC adapter.

Philips' AZ7883 Personal CD player

Good points: Unstoppable playback, good audio quality from headphones, small and light.
Bad points: Not much, except that there's no belt clip
RRP: $299.
Available: Contact the Philips Sales Centre on 1300 651993, or any Philips AV dealer.

grammed in advance, and any track can be stored more than once. This allows you to break from the set track order, but unlike shuffle play (which is also available), you'll never get your least-favourite track three times in a row.

As well as Shuffle, there's Shuffle Repeat All (continuous random play of all tracks), Repeat (loops through the current track) and Repeat All, which loops through the whole CD.

You also get Dynamic Bass Boost (as standard on just about everything these days), but quite frankly with the full-size headphones supplied, it isn't really necessary. The phones themselves give great performance, but they do look a little geeky — I doubt that you'd really want to be seen wearing them on the street.

The player is also quite light, at only 265 grams (including batteries and a CD), and it really couldn't get much smaller.

Good performance

All in all, the AZ7883 gives performs well, sounds great, is easy to drive, and even looks the part with its futuristic metallic look. The only complaint I had (well OK, its only a niggle) was that there was no belt clip of any kind, so you're stuck carrying the thing everywhere as it's too big to fit in your pocket.

Oddly, they also include a button to disable the ESP function. Press it, and the player skips all over the place when you shake it. I'm sure they only put it there to show off...❖

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This unit measures 184cm long & 141cm high. It features Santa in his sleigh loaded with presents. Colours red, green, blue, white & yellow. Power consumption 755W 240VAC. 8 metre power cord. Sturdy metal frame with mounting lugs. **Cat. SL-2900**

only $449

MERRY XMAS

Measuring 213cm wide by 101cm high. The Merry Xmas motif is rendered in an attractive 'script' writing style in a scarlet red. Two yellow/white stars provide an attractive highlight. Power consumption 410W 240VAC. 8m power cord. Sturdy metal frame, mounting lugs. **Cat. SL-2902**

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SANTA'S SLEIGH WITH 2 REINDEER

Measuring 2.6 metres long by 57cm high. Santa is seen riding his sleigh pulled by two trusty reindeer. Attractively coloured scene. Power consumption 574W 240VAC. 8 metre power cord. Sturdy metal frame with mounting lugs. **Cat. SL-2904**

only $399

CHRISTMAS TREE WITH DECORATIONS

Measuring 133cm high by 111cm wide. It features a green tree in the classic style with 3 contrasting red decorations. You can add real decorations to the tree to enhance the effect. Power consumption 410W 240VAC. Sturdy metal frame. **Cat. SL-2906**

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FESTIVAL BELL WITH DECORATIONS

This unit 60cm (24") high & 34cm wide features a yellow/white bell garlanded with green holly & red ribbons. Ideal for window or door display or part of a large outdoor display. Power consumption 96W 240VAC. **Cat. SL-2908**

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Attractive 5 pointed stars in four different colours. Sold individually.
RED Cat. SL-2930
GREEN Cat. SL-2932
BLUE Cat. SL-2934
YELLOW Cat. SL-2936
Power consumption 240VAC. Dimensions 34cm x 24.5cm.

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Large Indoor X'mas Lighting

MERRY CHRISTMAS

This unit features the full wording of the greeting in an attractive red handwriting script. The decoration is enhanced with two birds in flight above & below the writing. Sturdily framed for years of service. Ideal for restaurant windows etc. Power consumption 66W 240VAC. Size 57cm x 52cm. **Cat. SL-2910**

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PLAIN GREEN CHRISTMAS TREE

Attractive green classic shape 33cm high x 26.5cm wide. Ideal indoor/window illumination, designed to be garlanded with real x'mas decorations or as part of an overall christmas effect. **Cat. SL2938**

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'ICE' Ropelight

4 colours, red, yellow, blue & green set in a frosted plastic 'rope' 17mm dia 10m long. The translucent effect is like lights under ice! 180 bulbs in all. Power consumption 96 watts at 240V. Comes with a dedicated controller which provides 8 distinct lighting effects from 'chase' to 'sparkle' to 'slow fade', etc. Quality product, very long bulb life. Cat. SL-2820 **$59.95**

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'Twinkle' Lights

These are the most enchanting light sets we have ever seen! We provide this product in a 4 colour set (red, yellow, blue and green) or in a one only "candlelight" gold colour - which happens to be our favourite! The set consists of a 5 metre long master wire bundle bonded together with the fairy globes spaced evenly along the bundle. The globes themselves have an extremely long life. If a bulb does burn out or is broken the set will still work OK. An in-built dedicated controller provides a tranquil 'shimmering' effect as well as other decorative effects. Quality - will last for years. 92 watts, 240VAC. Internal use only.

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Christmas Star Kit

Refer: Silicon Chip November 1998
This fun kit is a microprocessor-controlled array of 30 LEDs in the shape of a star. The pre-programmed microprocessor generates over a dozen fascinating patterns for eye-catching christmas decorations. 30 premium red LEDs, pre-programmed micro plus all electronic components.
This is a PIC project. Cat. KC-5253 **$29.95**

Xmas Tree LED Kit

Ref: SC Nov 99. A spectacular light show in the shape of a tree. 32 bi-colour LEDs (red & green) light in multiple patterns, controlled by the on board microprocessor. Kit includes tree shaped PCB, programmed micro & EEprom and all electronic components. Size 135 x 100mm (base). 12VDC required - use our MP3006 plugpack. Cat. KC-5280 **$49.95**

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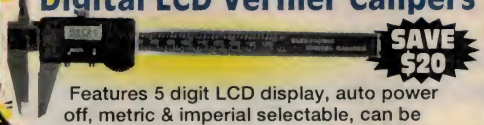

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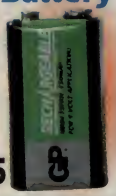

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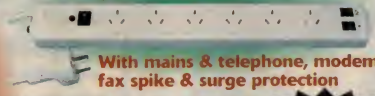

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COMPUTER CLINIC

Stripping out and re-installing Windows every now and then isn't a bad idea — so long as you know what you're doing. But wait! You're reading Computer Clinic. You'll have no problems at all then...

One of the most irritating facts of life with Win95/98 is that, just like a Tamagotchi, the system has a limited life. If you take good care of it and don't throw it any surprises, then it can last for years and years without any trouble whatsoever, but once you start experimenting with settings and installing or removing software at random, they day will soon come when your OS just can't cope.

Bluescreens, slow performance, just plain bizarre behaviour from applications — all are symptoms of an installation that's past its prime. You can go on fixing things for a while, but there will come a time when you're best off simply reinstalling.

For home or personal use, I recommend reinstalling 95 every six months or so whether it needs it or not. It doesn't take long, there's less chance of something going seriously wrong, and you get a chance to *finally* get rid of the last traces of that awful app that didn't uninstall properly...

Of course, if a virus chews on your hard drive, or you're starting from scratch, then you have no choice in the matter...

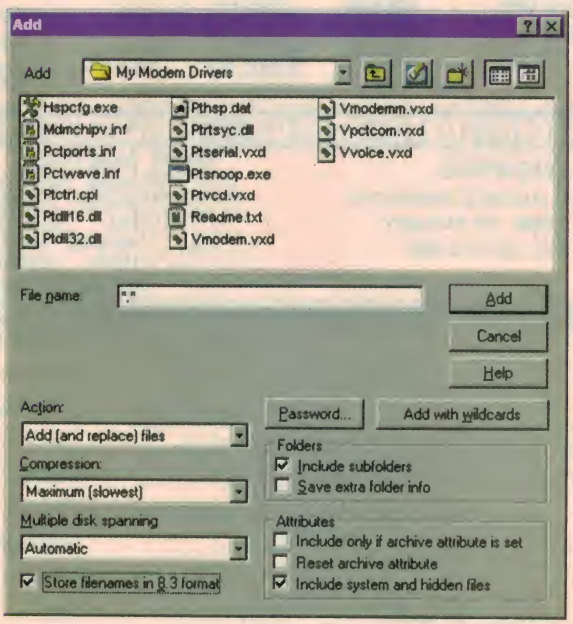
Backing up

Now, you may have heard of reinstalling Windows over the top of an existing installation, to preserve all your application settings and data. You can certainly do this if you want, (simply stick the Windows CD in and run SETUP) but I really don't recommend it. There's no telling what random junk can get left floating round the system, and it doesn't take a minute to reinstall your applications off CD anyway, so quite frankly you're much better off with a clean install.

The first thing to do before you start is to get all of your data backed up. This is one good reason for using the 'My Documents' folder to save everything in, as it means you can find all your files on one place, rather than having to root through the entire drive looking for that letter you put somewhere...

Never mind about programs, you should have them on CD, or be able to re-download them from the web. If you have original installation files on your system then by all means back them up, but otherwise it's a waste of time. The only other thing to worry about in most cases is your email, it's easy to forget it when backing up.

By editing the properties of the My Documents folder in Windows 98, you can change the default directory for most Windows apps.
With built-in disk spanning, WinZip makes the process of backing up your data a breeze.

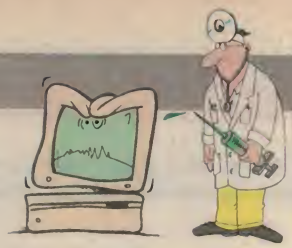


If you're using Outlook Express 4, go to **http://support.microsoft.com/support/kb/articles/Q188/8/54.ASP** for instructions on backing up and restoring your mail; for Outlook Express 5, simply grab the folder that contains your .DBX files. (somewhere deep under C:\Windows\Application Data — the exact pathname varies) To restore email in OE5, simply point the Import Wizard at the saved directory, and it will do the rest automatically.

Once you've got together all your irreplaceable files, you need to put them somewhere. A directory on a nice file server is ideal, (I keep all my documents there to start with anyway...) but failing that, stick them on another drive or partition, or if all else fails, back them up to floppy.

You can use dodgy old MS Backup if you like, but Winzip (**www.winzip.com**, shareware, US$29 and utterly indispensable) does multiple-disk spanning, and really is a lot more flexible. If you must backup to floppy, make sure to use the /V verify option — floppies are not the most reliable form of data storage on the planet.

Of course if you're not going to be formatting or repartitioning, you can always stow everything in one directory on the root of the drive, and skip the next section. Note that if you choose not to format, you'll need to delete the Windows directory (and anything else you're not specifically keeping) by hand before you reinstall.



Got any computer queries? Whatever is bugging you, from hardware problems to C programming, send it in and we'll soon have you fixed up. You can email your question to electaus@fpc.com.au, or fax or mail it in to us here at EA.

Slash and burn

Right, now that you only have disposable data on your drive, you're free to wreak havoc. Make sure that you have a CD-ROM bootdisk (If you don't have one, try the cdrom-god, now located at **http://www.gankish.net/rumblesoft**) and your install CD, and we can begin. A Win95 Emergency Startup Disk is a handy thing to have; it has FDISK and FORMAT and a few other useful commands included on it. Make one in Control panellAdd/remove programs->Startup Disk, then shut down and boot off it.

Before you reformat the drive, you might take a look at repartitioning. If you had a lot of data to back up, then a separate partition for data files save an awful lot of hassle next time round.

By partitioning your drive into two smaller logical drives, you can keep your born-to-die operating system on one partition, and your irreplaceable files on another. That way, no matter how much of a mess your C: drive gets in, your data will always be safe and secure on D:. Note that partitioning your drive destroys all data on it, quite irrevocably, so triple-check that there's nothing else you want to back up.

Fun with FDISK

The following looks more complicated than it actually is, and you only have to do it once, so read on.

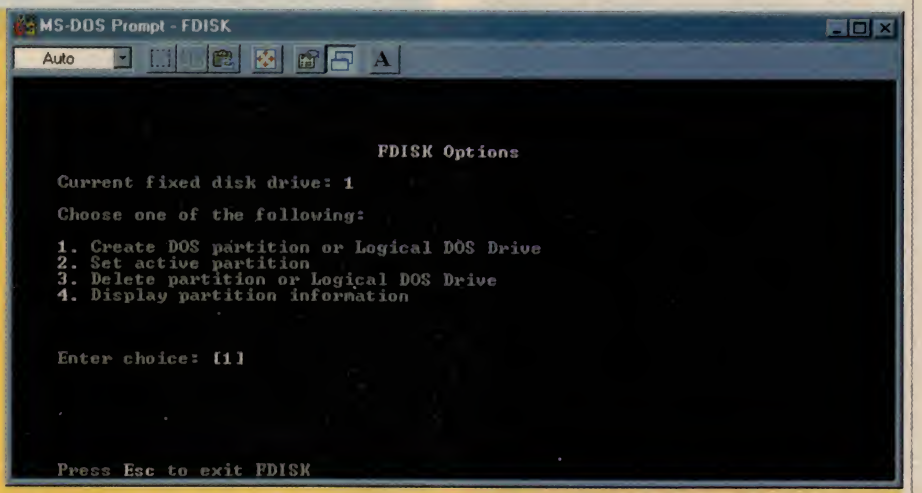
To partition your drive, run FDISK from the A:> prompt. If you have Win98 or a later version of Win95, you'll be asked if you want to enable Large Disk Support. This will cause your drives to be formatted with FAT32, the latest filesystem from Microsoft, instead of the good old FAT16 that we all know and love.

FAT32 has many touted advantages, including the ability to handle drives larger than 2GB in one partition, and a smaller cluster size, making for more efficient storage of small files. However, it's only readable by 98 and the later versions of 95; the drive will not be accessible if you ever boot another operating system such as MS-DOS (off an old floppy, for example), Windows NT or Linux. (at least, not natively. There are ways and means, but it's not fun)

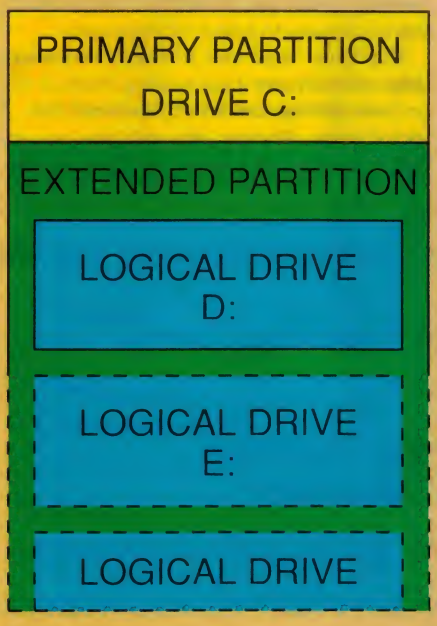
Having made your choice, you should be presented with the FDISK main menu, as shown. (This example will assume that your drive is currently configured as one partition). What you want to do is to delete the existing partition, and create two new smaller ones in its place. Just to complicate the issue, while DOS/Win95 machines can have as many drives as you like, they only support two actual partitions: primary and extended. The primary partition is a drive in itself, but the extended partition is merely a placeholder for *logical drives*.

For this example, I'm taking a 2GB drive configured as one big partition, and splitting it into two pieces: 1GB for the operating system and software, and 1GB for data. You'll want to modify this to suit your own requirements, but it should give you the general idea.

First up, choose option 3 in FDISK to delete the primary DOS partition. Your drive is now blank, and ready to accept new partitions. Use option 1 on the main menu, followed by 'Create Primary DOS Partition' to create a new one. Give the primary partition a size of 1024MB (1GB), then use option 2 to set it active, so that you'll be able to boot from it. You now have a C: drive once more, but it's been reduced in size to 1GB.



The FDISK main menu. Just like Bill Gates, it's boring, but insanely powerful.



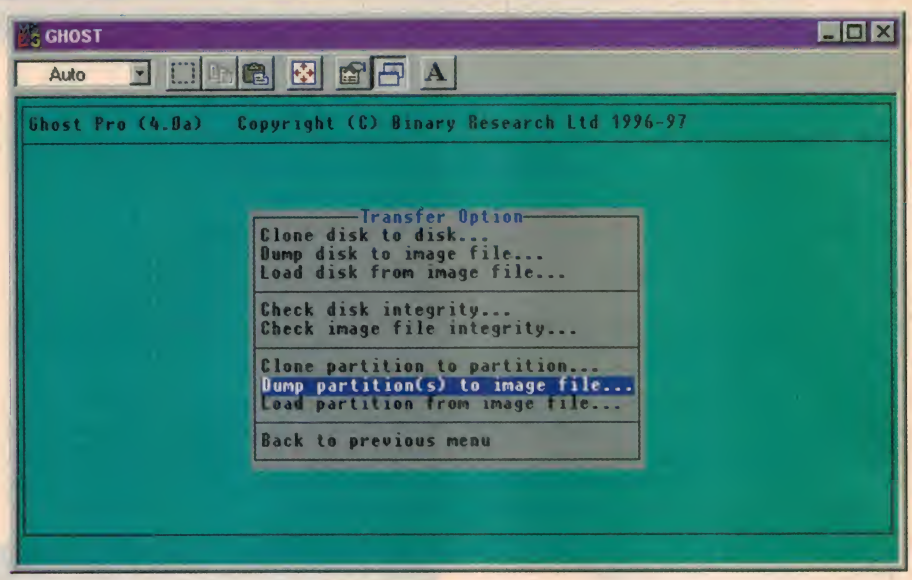
Now create an extended partition, again with option 1, this time selecting 'Create Extended DOS Partition'. Allocate all the remaining space to this partition (in this case, the other 1024MB). The next step is to create the logical drive D: in the extended partition; use option 1 again, then 'Create Logical Drive in Extended DOS Partition'.

If you wanted more than two drives on your machine, this is where you'd add them, dividing the remaining space in the extended partition between the logical drives. As it is, though, we'll go with just one, so allocate all the space in the extended partition to the new logical drive.

At this point you must reboot, as DOS doesn't realise the partition table has been changed, and will get in a horrible mess if it tries to write to the drive in its current state. Stick the boot floppy in the drive and reset your machine, and we're ready to start formatting. Type FORMAT C: to format your C: drive (amazingly enough), then FORMAT D: to format D:. Now your drives are ready to install Windows.

computer clinic

Norton Ghost. Also geeky, and not much too look at, but can save hours of tedium.



Putting it all back

Boot from your CDROM boot floppy, and insert your Windows CD. Now, you could just install from the CD, but to save yourself hours of mucking around later on, type COPY E:\WIN95 D:\ (or E:\WIN98 if you have Windows 98...) to copy the installation directory to your data drive.

Not only is the actual installation process a lot faster this way, but it also means that you'll never have to worry about CDROM boot disks again, or scrabble round looking for your CD whenever you change system settings. It'll take anything from 32MB to 170MB of space, depending on the version of Windows, but it's a small price to pay for the convenience you get.

Run SETUP from the directory you just created, and you're away. If you have an 'upgrade' version, don't worry, you don't need to install the previous version of Windows first. Just insert the install disk for the previous version when prompted, and it will install quite happily. Do make sure you select the 'Custom' install type, so you can select the components you want.

Windows will work just fine no matter what you choose here, and you can save an awful lot of disk space by leaving out rubbish such as the Phone Dialler and Compression Tools. (Never, never use Win95 drive compression. It WILL die on you at some stage, and you'll lose everything. Trust me.) If there's anything you later discover you do need, you can always add it by going to Control panel\Add/remove programs\Windows setup. The actual process of installing is quite simple; you might want to check that you set the default language settings to English (Australian), but apart from that there's virtually nothing to get wrong.

Now your system should be up and running, but there are a few more things to do before you are back in business. First up, install any drivers for your motherboard, video card, sound card, or other assorted peripherals. Generally speaking, all you have to do is bung the CD in the drive, and run the setup program. Where possible, though, go for the 'Custom' install and try to avoid the accompanying useless utilities that hardware vendors have a habit of including with their drivers.

Re-exploring

Next comes Internet Explorer (unless you're a Netscape user). If you want the rather handy toolbars and nice buttons in Windows Explorer, install IE4 first, with the shell upgrade, and then install IE5. For some reason, MS left this extremely handy shell upgrade out of the IE5 install... I still have no idea why, it's the most useful thing to happen to Windows yet.

One thing to look out for is to make sure that you disable the IE4 tour that appears at boot-up before you install IE5. If you don't, there's no way to turn it off afterwards.

That done, head over to **http://windowsupdate.microsoft.com** if you're using Windows 98, or **www.winmag.com/win95/update95.htm** if you're using Windows 95, and pick up any updates and service packs that look useful.

One last thing to do if you're using Win98 is to right-click the 'My Documents' folder on the Desktop, go to Properties, and set the default location to your new D: drive. That way, most apps will look for documents on D: by default.

Ghost of the machine

Congratulations! Your system is now clean as a whistle, and should give you months of trouble-free performance. Before you go reinstalling your applications, though, there's a rather handy way to save yourself all this mucking around for next time. Get yourself a copy of Norton Ghost ($63US, **http://www.ghostsoft.com/sabu/ghost/ghost_personal/**), which can take a snapshot of your drive and save it to a compressed image file.

Once you have an image file of a freshly-installed system, you can restore your machine to that state in five minutes flat, any time you want. This is a huge timesaver, and takes all the pain out of getting systems up and running. It's a little pricey for the casual user, perhaps, but after your third all-night reinstalling session after a crash, you'll realise just what a boon it is. Check it out! ❖

VINTAGE RADIO

by Roger Johnson

Some unusual Healing practices

No, this month's story has nothing to do with the Australian Medical Association, or alternative health care! We're talking about A.G. Healing and its receiver models of the early 1930s, which used some quite unorthodox ideas. The company was also one of the few major manufacturers to venture into direct coupling.

THE AUSTRALIAN FIRM of A.G. Healing, according to their 1932 Radio Guide, was established in 1897. They described themselves as "the largest, most friendly and most capable wholesalers serving the Radio, Automotive, Bicycle and Plating Trades. The opening of the Radio Sales and Service department last season marked another step in the progress of this Company."

The firm was the distributing agent for Osram valves, and sold a host of household electrical items as well as a vast range of radio parts and equipment, including practically every known brand and type of valve available!

The *Guide* showed photos of their factories in Goulburn Street, Sydney; Franklin Street, Melbourne; and Pirie Street, Adelaide. The service literature that is available suggests that the first models which were released were designated 1932 models.

Fig.1: One of the very first model Healing sets, the table model H3D 2V. This example has not been restored.

Models for 1932

One of the very first Healing sets is shown in Fig.1, a model H3D 2V. As you can see, it is a timber box table cabinet with a separate electromagnetic Jensen speaker in its own cabinet.

Here we have one of the first departures from what was then standard practice: the speaker plug is NOT the standard 'UX' four-pin plug. There *are* two thick pins and two thin pins, in a nominally UX layout, but the two pairs of pins are diagonally opposite one another.

The circuit, shown in Fig.2, is a two-stage TRF without reaction, direct-coupled to a type 245 triode output. Direct coupling has been covered before in this column, particularly by my predecessor Peter Lankshear in his August 1991 article on the 'Loftin White' amplifiers.

However there were some minor differences between the Loftin- White circuits and direct coupling in domestic receivers. A study of the circuit will show that the full filtered rectified output voltage, about 420 volts, is applied to the anode of the 245. This seemingly far exceeds the maximum rating for a type 245, and this would be the case if the anode voltage was measured with respect to earth; but of course valve potentials should be measured with respect to cathode.

In this case the centre-tapped filament of the 245 represents the cathode, to which is connected the speaker field and R4, 5 and 6. Together these total over 7000 ohms, so that with entire cathode (in this case, anode) current flowing through them there is a voltage drop of some 200V from cathode to earth. As a result, the anode-cathode voltage for the 245 is actually only 220V or so — much more respectable.

Shunted across both the 245 and its anode load (the speaker transformer primary winding) is R8 and R9. These in effect form a voltage divider to derive the anode supply voltage for the 224A detector stage. Resistor R7 forms the anode load for the detector, and also the grid leak of the output stage because of the direct coupling. The values of R8, R9 and R7 would be adjusted to make the grid voltage of the 245 about 140V positive to earth, or 60V less than the cathode — giving a bias of about -60V, about the right figure. .

Volume control is by variation of the screen voltage of the RF stage, another type 224A, using pot R2 which is also connected from the output stage cathode to ground.

Detection is by the 'anode bend' method, and there is provision for a gramophone pickup. This is connected between grid and a slight positive potential — presumably to ensure that the valve operates in more of a 'class-A' mode. As has been mentioned before, some manufacturers simply connected the pickup between grid and earth in valves operating as an anode bend detector; a very poor design practice.

Pot R5 is a preset chassis control, and not a panel control, and is used to minimise hum. Apart from tuning and volume the only other panel control is the antenna coupling switch.

As you can deduce from the photo, this set has not been restored to operating condition (despite it being on the shelf for at least 15 years!). However a very similar circuit with an almost identical front end, but using conventional R-C coupling to a type 247 output valve

has been restored. Performance is not particularly good. Very careful adjustment of antenna length, antenna coupling and alignment is required to eliminate adjacent station interference. It is almost a fundamental requirement that alignment is done *in situ* — alignment in a repairer's workshop is no guarantee of success if it is moved to another location.

Two-valve models

The Healing model 20 is a 2/3-valve set using the rarer Mullard S4VA direct coupled to the Osram PX4, and the reliable 280 rectifier. However this circuit at least uses regeneration.

The model 201 is also a direct-coupled combination of a 224A and 247, but here regeneration is used and adjusted by varying the screen voltage. The potentiometer is shunted across the reaction winding, so that as well as reducing the voltage it 'dampens' the winding.

Healing's model 22 and 23 are conventional 2/3-valve regenerative detector designs. The former uses a 47/247 combination and the latter a 57/59 pair. The volume control in these two circuits is a 10k pot in the earthy end of the aerial coil primary. It is actually designated 'selectivity' (the very nerve — as if there is a choice!) and has the unfortunate habit of slightly de-tuning the station when the setting is altered.

Healing produced conventional 2/3-valve TRFs in 1934 (model 24) and 1935 (model 25E) using 6C6/42 combination. In fact along with 'Eclipse', they were the last factories to produce radios of this type.

Healing anomalies

As the old saying goes, all that glistens is not gold. Despite a given model being described in the service literature, minor variations did occur that were not always recorded. One such example is the Healing model 33, of which two very original examples have been seen.

Now the service diagram shows the line-up as 58/57/59, with an RF stage and a regenerative detector with grid leak detection. But of the two examples that were seen, one had a 58/57/59 lineup using anode-bend detection, and the other used a 58/57/47 combination using grid leak detection...

There was no doubt that each chassis was a model 33. The little name plates which are bolted to the chassis clearly showed the model and serial number, which was also stamped into the underside of the chassis for good measure.

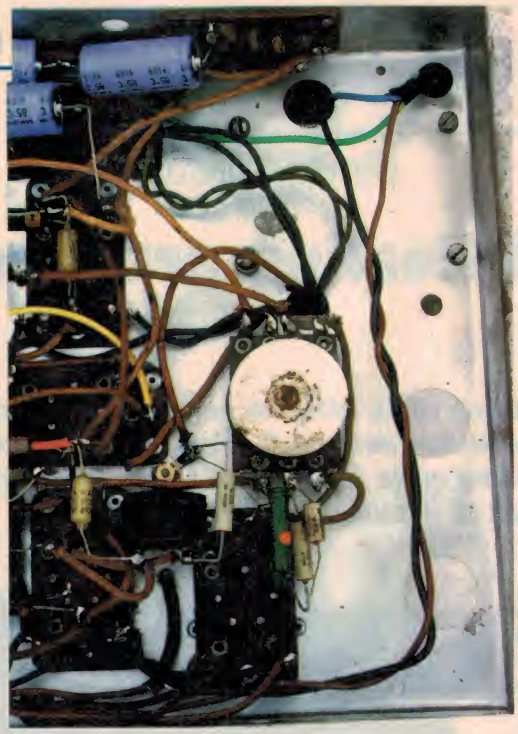


Fig.4: The oscillator coil of the model 60. The metal disc is the unusual padder.

Four-gang tuning

In the years 1932 to 1934, as far as can be determined, Healing produced 17 TRF models and 28 superhets, of varying size and complexity for both battery and electric operation. In the 1932/33 period, six models were produced that had an enormous four-gang tuning capacitor, identical to the very first AWA four-stage TRF model of 1932 and which also appears identical to the Atwater Kents of similar vintage. The circuit for one of these jobs, a model 60, is shown in Fig.3.

The models 40 and 41 were three stage TRFs with pre-select or bandpass tuning in the first stage. The model 40 was doing its best to overload a direct-coupled type 245 output!

The model 50 used a tuned RF stages, and plugged straight into the DC mains without any isolation whatsoever. The valve types were the very first series 6.3V indirectly heated types 239 and 236, and a conventional C443 output. The filaments were wired in series and supplied from an enormous wire-wound voltage dropping resistor, which looks as though it could be placed at the front of the cabinet and doubled up as an electric radiator!

Th electric models 60 and 61 were superhets with a tuned RF stage and bandpass tuning, and incorporated a speaker field of 7500 ohms which was placed directly from HT+ to earth.

Finally, the battery model 65 was also a TRF with an RF stage and bandpass tuning, anode-bend detection and with class B push-pull output. This set is particularly curious in that the two RF stages and the detector all used types 232. The output valves were type 30s, but the driver was an A415, which by 1932 would just about be obsolete.

The 'A' supply was 4.0 volts, and each of the other five 2V valves had a 33-ohm resistor in series with the filament. One wonders why they bothered. Surely it would have been just as simple to incorporate a type 30 as a driver, like a host of other manufacturers — including Healing themselves?

Unusual practices

We now come to some other quirks of Healing manufacture. Firstly, in the 1932/33 period they used a very shallow chassis. There were two sizes (large and small), and all of their models with the

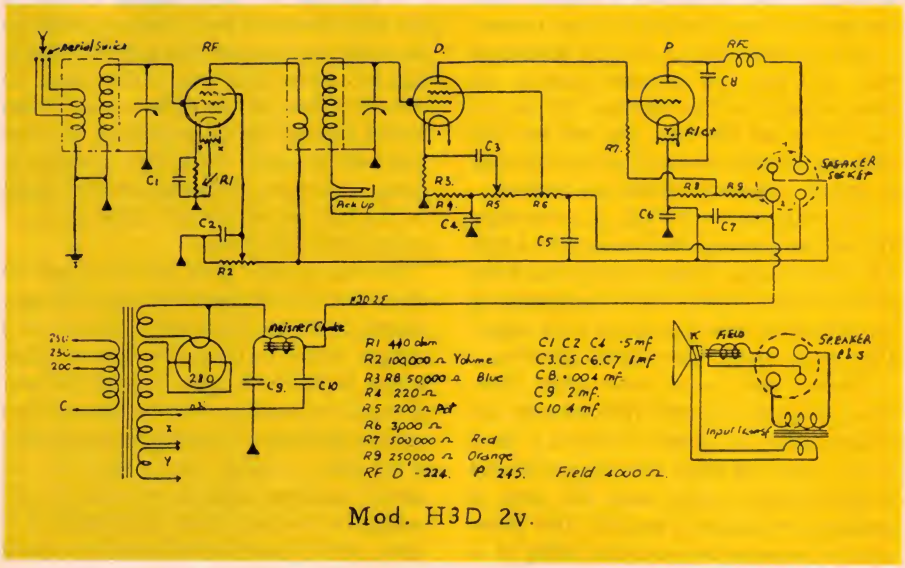


Fig.2: The circuit of the H3D 2V table model, with its direct-coupled output stage.

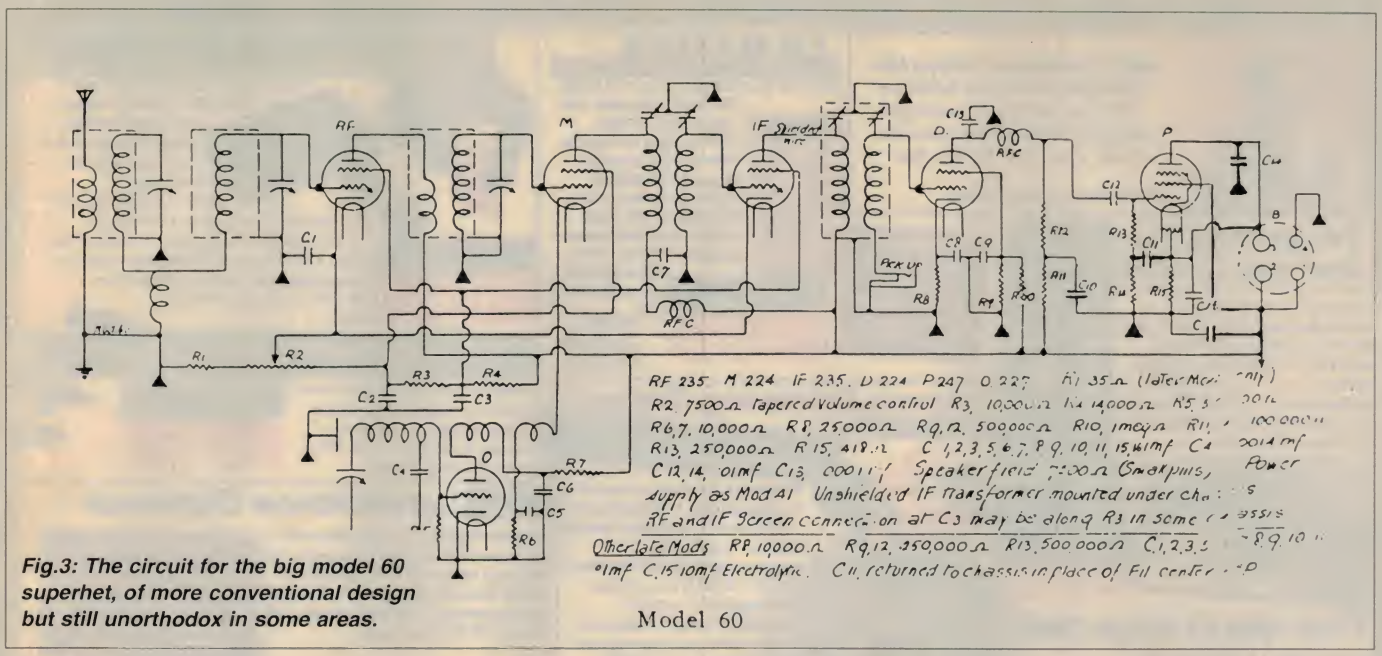


Fig.3: The circuit for the big model 60 superhet, of more conventional design but still unorthodox in some areas.

exception of the two table models were built onto one or the other. Unused valve socket and/or IF transformer holes were simply left vacant.

In the big battery superhet model 73B, there are no holes in the IF cans to allow access to the trimmers. One might suppose that the trimmers are mounted at the base of the coils, and access is via holes in the chassis. WRONG! It is necessary to remove the can and adjust the trimmers whilst the coils are unshielded. One can imagine all sorts of instability, which does not seem to occur, at least if they are aligned one at a time. It was thought that if a jam tin with both ends removed was placed over the IF and earthed with a wire and a pair of crocodile clips, then that would contribute to stability. However, this proved totally unnecessary.

A point about the IFT's of the model 60 in particular is that the adjusting trimmers are connected between plate and earth, and not plate and HT. There is of course no particular reason to query this practice; it's just that it is a little unorthodox.

Notice the 'front end' of the model 60 circuit. We see that the oscillator coil has a line drawn to the left of the coil, which is earthed. This represents the padder, and was used on several of their models (60, 73, 53 and 55). The oscillator coil is far from conventional. It is a disc shaped coil (both windings) with a bolt passing through the centre of the 'former'. To the free end of the bolt is attached, via a pair of locking and adjusting nuts, a disc approx 2" in diameter. The spacing of this disc from the coil represents the padder adjustment.

Note the bandpass coupling coil in the antenna circuit. It is a small coil on a shallow 1" diameter former with a few turns of wire, exposed under the chassis and connected to the shielded coils just as shown.

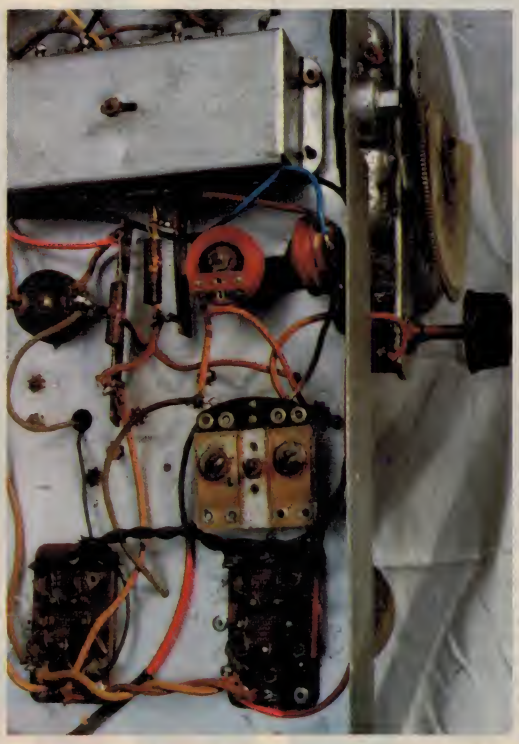


Fig.5: A somwhat unorthodox under-chassis IF transformer in the model 60, with its alignment trimmers.

Another foible of the model 60 is that the IF valve is in the front corner of the chassis, and the grid lead of considerable length, unshielded, travels along the top of the chassis and enters through the chassis to a most unusual IF transformer. A picture tells a thousand words, and this IFT together with the associated earthy trimmers, are shown in Fig.5. Despite this, instability has not been a problem.

Unfortunately there is insufficient space to show all the photos and circuits.

Other superhets

Mention has been made of the large model 60 electric set and the model 73B battery set, but a couple of others deserve mention. The large model 73 has a preselector front end, separate oscillator, IFT's as described above and a new 2B7 detector/audio driving a pair of parallel type 59's. The model 73-1 also has a preselector front end, but with a more conventional oscillator, a tuning meter and a type 55 detector R-C coupled to a type 56 driver, which is transformer coupled to a pair of 245s in class-B. This model is equipped with two speakers, with commoned voice coil connections, but with their fields connected in series.

Although the *Radio & Hobbies* 'Little General' was claimed to be the first 3/4-valve electric superhet (which is debatable), the output valve of that particular circuit was driven direct from the diode load. In the Healing model 34, the line-up is a 2A7 mixer and one IFT driving an anode-bend detector type 57, which in turn drives a 2A5. There is no AGC, and the circuit probably worked quite well.

In closing, the early Healings had other quirks, such as output circuits using both parallel and push-pull configurations using types 59 and 45, in their big sets. But generally speaking they were well made, with heavy gauge plated steel chassis and good quality Jensen speakers. ❖

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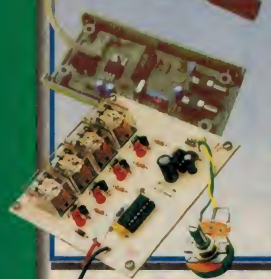

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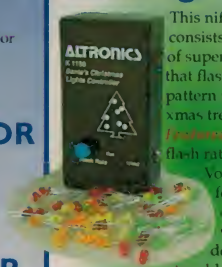

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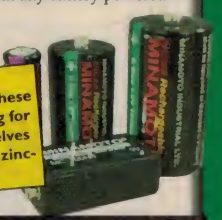

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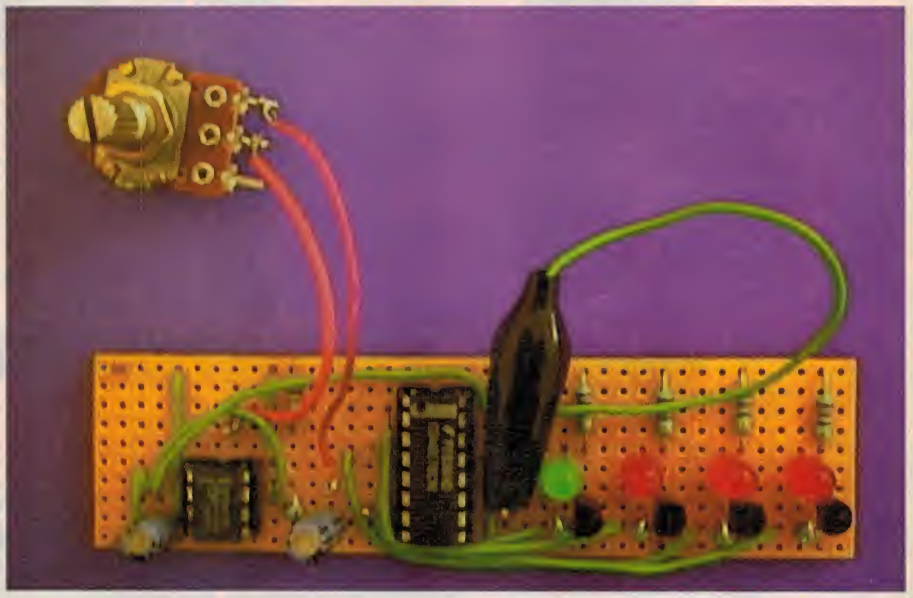
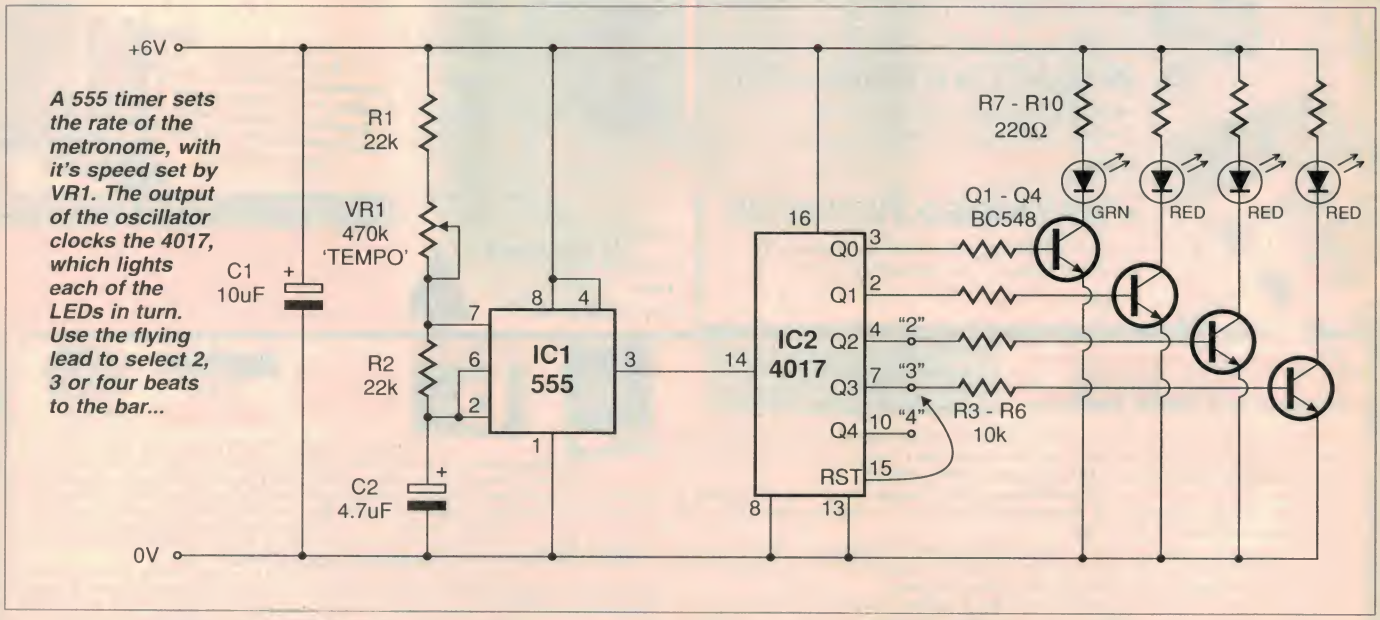
Although it is primarily intended for budding musicians, it has applications in other activities, such as aerobics.

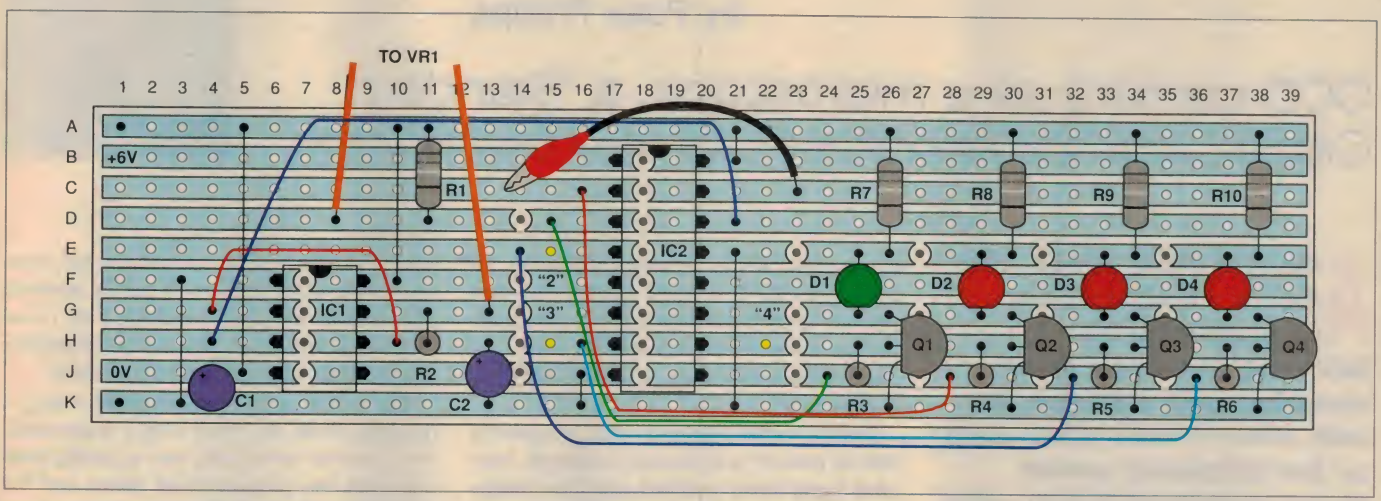


How it works

The ever-popular 555 timer IC performs the timing function. In Fig.1, IC1 is wired as an astable, that is to say it produces a continuous rectangular wave. The variable resistor VR1 sets the frequency. If this is turned to maximum resistance (470k), the frequency



A 555 timer sets the rate of the metronome, with it's speed set by VR1. The output of the oscillator clocks the 4017, which lights each of the LEDs in turn. Use the flying lead to select 2, 3 or four beats to the bar...



When constructing the metronome, make sure that you cut the tracks under the transistors -- at holes H27, H31 and H35.

is 0.6Hz, a rather stately pace. If it is turned to minimum resistance (zero ohms), the frequency steps up to a lively 4.6Hz.

If you want to design your own metronome to cover a specified range of frequencies, the equation for calculating frequency is:

f = 1.44/(C * (R + (2 * R2)))

In this equation, C is the capacitance of C2, and R is the value of R1 and the set value of VR1 in series.

The signal from the timer next goes to a counter, IC2. Most digital counter ICs have binary outputs. That is, there are four or more outputs that run through a sequence of binary numbers as the counter is incremented. For example, with a 4-bit counter, the outputs run through the sequence 0000, 0001, 0010, 0011, on to 1111. They are counting up from zero to 15 (decimal) and then repeat.

The counter in this circuit is different. It has 10 outputs and only one goes high at any one time. When the counter is reset by briefly making the reset input (pin 15) high, output 0 (pin 3) goes high and all other outputs are low. When the first pulse reaches the clock input (pin 14) output 0 goes low and output 1 (pin 2) goes high. At the next pulse 2 goes low and 3 goes high. This is repeated for all outputs in turn, up to output 9, and then repeats beginning at output 0 again. A counter of this type is known as a ring counter or occasionally as a Johnson counter.

In a metronome circuit we want the counter to cycle through shorter sequences such as those listed earlier, with either 2, 3 or 4 beats in the sequence. To obtain a 3-beat sequence, for example, we need the outputs 0, 1 and 2 to go high in turn and then repeat from 0. This is easy to arrange. We connect the reset input to output 3. When 2 goes low and 3 goes high, this immediately resets the counter to 0. It happens so quickly that it appears that 0 goes high immediately after 2 goes low. The counter now cycles 0, 1, 2, 0, 1, 2, ... indefinitely. Note that although the outputs are labelled 0, 1 and 2, we actually number these as beats 1, 2 and 3.

The four outputs are wired to resistors R3-R6 and through these to transistors Q1 to Q4. These are connected as transistor switches to control the LEDs. The first of these is a green LED and the other three are red.

Construction

The circuit is easily assembled on a small piece of stripboard. Build the timer circuit first. This circuit uses the original bipolar timer IC, which tends to produce rather heavy spikes on the supply lines as it changes state. Spikes on the lines could cause the counter to mis-count. For this reason we have wired C1 across the supply lines, with its connections as close as possible to the power terminals of IC1. This absorbs the voltage spikes as they occur.

Note that the value of C1 is not critical, and if you have a 4.7uF, 22uF or other nearby value in your spares box you can use this instead. When the timer circuit is complete, use a multimeter to check the output from pin 3. This should alternate between 0V and 6V at a rate dependent on the setting of VR1.

Next assemble the counter. To keep costs low we use a crocodile clip to be clipped to one of the terminals pins labelled '2', '3' or '4' in Fig.2. This sets the number of steps in the cycle, which is the number of beats in the bar. A 3-way rotary switch makes it easier to change the rhythm, though it is more expensive. At this stage check the outputs of IC2. With the crocodile clip on the 0V line, the counter runs its full cycle of 10 and they all produce a high pulse at one tenth of the rate of the timer. With the clip on pins '2', '3', or '4' the cycle is shorter and the pulses come more frequently.

Finally add the transistor switching circuits. Take care to cut the copper strips at exactly the right places as shown in Fig.2. Now you are able to see the LEDs flashing in sequence, the number in the sequence depending on which pin the crocodile clip is connected to.❖

Parts List

Resistors

(5%, 0.25 W)

R1, R2	22k
R3 - R6	10k
R7 - R10	220 ohms
VR1	470k potentiometer

Capacitors

C1	10uF 16VW electrolytic, radial leads
C2	4.7uF 16VW electrolytic, radial leads

Semiconductors

LED1	5 mm green LED
LED2,3,4	5mm red LEDs
IC1	555 timer IC
IC2	4017 decade counter
Q1 - Q4	BC548 NPN transistor

Miscellaneous

Stripboard 26 x 100mm (10 strips x 39 holes); 7 x 1mm terminal pins; battery holder (4 (1.5V cells); 8-pin IC socket; 16-pin IC socket, Crocodile clip.

INFORMATION CENTRE

by Peter Phillips

CCD camera as a microscope, a 'Standard Cable', and the benefits (?) of new technology

Amongst other things, this month we discuss the venerable Variac, including how to go about repairing such a device. As well, there's more discussion on the telephone socket tester described in July, uses for a CCD camera module, and readers give definitions for a 'Standard Cable'. And of course, as it's that time of year, my best wishes to all readers.

For some time now this column has been sponsored by Allthings Sales & Services, who kindly donate a prize each month to the writer of the most interesting letter, etc. In July, this prize went to Jake van der Peyl (Auckland, NZ), for his letter describing a simple yet effective way of testing continuity between two telephone sockets mounted on a printed circuit board. At the time, I invited readers to comment on the circuit, and to offer a simpler solution. More on that shortly, but first a letter from Jake himself, who is clearly chuffed at receiving a CCD camera module, and who has found an interesting use for it that's worth passing on.

Thank you very much for the camera module, which I have mounted in a box with a 12V regulator, a power supply socket and a BNC socket; powered from a 16V unregulated plugpack. Next problem: find a job for it. I was thinking security, but a picture of the garden on TV day and night did not seem the way to go.

I tried to use the camera on my manual printed circuit board drilling machine, but because it could not be mounted straight above the machine, I gave up on that idea. But I discovered that the camera magnifies very well, so I mounted it on an adjustable stand (from a Dick Smith magnifier), along with a small 24V 40mA light bulb, and glued the stand to an aluminium sheet, as it was top heavy.

As a result, I now I have an excellent microscope, which is especially good for working on surface mount boards. The next problem is to find a reasonably priced video capture board for the PC. A great prize, and one I'll find most useful. (Jake van der Peyl, Auckland, NZ)

Thanks for this feedback Jake, it's good to hear of uses for a CCD camera module. I too have found these modules useful for magnifying a PCB to inspect soldered joints etc. Remember also that these cameras respond to IR light, which allows you to light the area being examined with IR LEDs. Some camera modules come with several IR LEDs mounted around the lens, and it's surprising the effect they have.

Now let's return to Jake's circuit, starting with this letter, in which the writer wonders why it was necessary at all.

Quality assurance

Regarding the socket tester in the July issue, what I find absolutely amazing is the apparent acceptance of a 10% failure rate. Surely the effort put into designing and building a tester to sort out the good from the bad could have been used to eliminate the problem in the first place.

It seems all the QA education in the 70s and early 80s we at the then DSIR tried to get into industry is for nought. It's no wonder New Zealand manufacturing went down the tube! It reminds me of a job I was given at Joseph Lucas more than 40 years ago. I was asked to design and build a non-destructive hardness tester to sort out good from bad windscreen wiper shafts that had been through an induction hardener, as the number of badly hardened shafts was becoming unacceptably high.

I produced a working prototype after two months, and then took it to the factory which was located the other side of Birmingham. However, after an hour watching the induction hardener do its job, it became apparent that the problem was a simple intermittent mechanical chucking fault. It taught me to always get to the root of a production problem rather than trying to inspect it out. (Terry Porritt, Upper Hutt, NZ)

These days quality assurance (QA) is a compulsory part of virtually all training for operators and others in the manufacturing industry. As you point out Terry, it makes sense to try and prevent quality problems from occurring in the first place, rather than building the device, then testing it to find the faults.

But in this case, it seems there wasn't a lot Jake could do. From what I understand, the sockets themselves had a quality problem, not the printed circuit board and the resultant soldering. Therefore testing was essential, which was best done after the sockets were mounted, so the testing process would check everything, not just the sockets.

Still, you make a good point Terry. If a manufacturing failure rate is excessive, it's time to look at the process and find out why. Relying on testing might find the failures, but the cost of throwing out or repairing faulty products after manufacture does not make economic sense.

Let's now return to the tester circuit itself and ask the question again: is there a simpler way? The original circuit is in Fig.1, and the following letter (the only one I received about this circuit) makes a few comments about it, and then goes onto discussing a few instances where today's technology is not necessarily better than older technology.

New versus old technology

The socket tester in your July column is a neat circuit. I don't know if it's simpler, but I do know of an older circuit from which it was developed. It had resistors in place of the optocouplers, and an ohmmeter measuring the total resistance. Lower than normal resistance indicated a short somewhere, and infinity showed an open circuit. It wasn't automatic, but it could easily be made so with a couple of op amps and some logic gates, but whether this is simpler than Jake van der Peyl's solution is a moot point.

This problem and the correspondence on the VNG receiver made me reminisce. Like Bruce Howard, my first reaction was that a rotary switch would have been a more elegant solution, but if these aren't available, that is that. However, I don't think much of the designer's argument that he wanted to use up-to-date techniques. The right criterion for using a particular method is that it's the

most suitable of those available. If older methods are more suitable, and available, they should be used. Actually, there are good arguments for not using a rotary switch in this case, even if available, as it would involve running critical wires close together to reach the switch.

Having started on this theme, please allow me to continue. There are several areas where modern technology or practice is inferior to the old. There used to be meters with the pointer moving between contacts, and able to operate an alarm if the current or voltage was outside limits. Such a meter could be used in the socket testing circuit.

There was a recent project of a digital scope and the text warned about the possibility of aliasing. There is only one foolproof way of preventing this: an analog low pass filter preceding the sampling. Sure it adds distortion, but that is the price that must be paid. A digital equaliser later on can compensate in part for the filter loss in the pass band. An optional filter which can be inserted would be a useful addition to the design. I wouldn't be surprised if some tests would not be better performed with an analog scope (if still available).

Again, a lot of radios these days have a first intermediate frequency in the VHF band, which avoids the need for tuned circuits in the RF stages. This makes for simplified design and reduced costs, but leaves the receiver open to cross modulation problems if it's close to a high power transmitter. I realise that solid state amplifiers are less prone to this than valves, but a while back, in Moffat's madhouse, he commented that in a difficult location he got better reception from an old radio. Maybe I am over sensitive to the problems of cross modulation because of my background in telephony, where it was a perpetual problem in carrier systems. (Harry Freeman, Wollstonecraft, NSW)

Thanks for your comments Harry. A test circuit based on a resistive network also crossed my mind, which as you say could have been automated by using a meter fitted with alarm contacts. I guess quite a few readers won't be aware of such meters, but I remember them well from my days as an instrument fitter working in power stations. They were reliable, easy to set and very visual.

Regarding your comments about oscilloscopes, I bought a digital/analog scope about four years ago, as I wanted the advantages of both technologies. The digital mode offers waveform storage and other useful facilities, but I generally use the scope in analog mode. Perhaps I'm behind the times, but I tend to trust an analog display more than a digitised version.

In saying this, I run the risk of being judged old fashioned by younger readers, but in some ways new technology has not improved electronic circuitry, although it often makes it cheaper to produce. Furthermore, it has also made electronics for the hobbyist more difficult, as evidenced by the VNG receiver design which required a considerable number of components to replace a simple switch.

While we're on the theme of old technology, you might remember a letter in the October issue from 'Old Wilbur', who wanted to know how a 'Standard Cable' was defined in 1875. I've had several letters in reply, so here's the first.

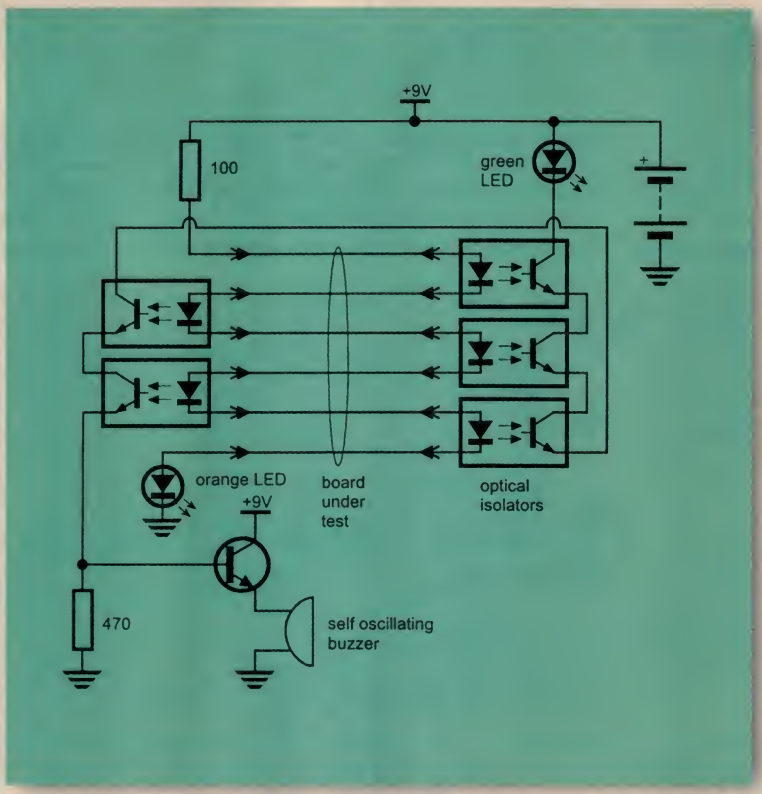


Fig.1: The circuit of the telephone socket tester as presented in July. The opto-isolators can be replaced with resistors, but extra circuitry is needed to give a visual or audible indication of the test results.

Standard Cable, 1919

In response to the request from 'Old Wilbur', I decided to trawl through my collection of old books on electrical engineering. These date from about 1905 up to 1930, and are a wonderful insight as to how things were done in the 'good old days'. I am always looking out for additions to the collection, but Perth doesn't have many secondhand bookshops. Anyway, after being sidetracked many times by various bits of irrelevant knowledge, I discovered this reference to 'Standard Cable' in a 1927 Mechanical World pocket book and diary:

Standard Data, Definitions and Conventions for Copper Cable. Standard Number 7 (1919)

The resistance of a wire one metre long and 1sq mm section (uniform) is 1/58 ohm (0.017241 ohm) at 20°C.

The resistance of a wire of uniform section one metre long and weighing one gramme is 0.15328 ohm at 20°C.

The resistance of a solid conductor 1000yd long and 1sq in is 0.0240079 ohm at 60°F.

Is this what 'Old Wilbur' is seeking? From my collection it seems that telephony and electrical engineering were combined, as all my books have articles on telephones, morse repeaters and signalling equipment, as well as motors and lighting circuits. I'll be interested to see what other EA readers come up with. (Steve Verlander, Yangebup, WA)

Thanks Steve for taking the trouble to find and send us this information. The next letter however has a different definition.

Standard Cable, 1905

The 1905 'Practical Telephone Handbook' 5th edition by Poole defines a Standard Cable as one mile of 204 pair dry core cable (that is, no impregnation with resinous oil), with each conductor wound with overlapped manila paper. In damp conditions dry air is pumped through the cable.

Each conductor (one of a pair) will have a weight of 20 pounds per mile, which equates to 20 SWG (0.036 dia.) and a resistance of 44 ohms. The insulation resistance between the wires of a pair must be greater than 200 megohms. The inductance of a mile loop is 1mH, and the average mutual capacity is 0.054uF. (Peter Lord, email)

This definition seems closer to what 'Old Wilbur' is after, as it relates to telephone cable, unlike the first definition which seems to be for power cables. So thanks Peter for sending me this information. I've also received a third letter on this topic, which gives a very detailed description about copper wire. As we're running out of space, here's a rather cutback version of the letter...

Standard Cable, 1908

There is a section on 'Copper Wire' in my Telephone and Telegraph Engineers Pocketbook (dated about 1908). It describes various aspects of copper, including its specific gravity, weight per cubic inch, the effect of impurities on conductivity and so on.

There are several pages of tables giving the gauge, diameter in mils, area in circular mils, pounds per 1000 feet, pounds per mile and pounds per ohm (at 20, 50 and 90°C), and a number of variants. There are too many to list here unfortunately, but using the annealed figure of 0.150822 ohm for a meter-gram at 60°F, I get 246 ohms per mile for a 'standard' cable. I have no idea how one relates that back to a loss in decibels. (John Penney, Blenheim, NZ)

I guess John that there are also a number of younger readers who are wondering not only about calculating a loss in decibels, but also about circular mils, pounds, miles and other good old imperial measurements. I've not converted these to metric, as it doesn't matter in this case, given that the above definitions are for comparison. Unfortunately, like me, Old Wilbur is probably wondering which one of these definitions to choose!

Variac problem

A useful item of workshop test gear is a variable autotransformer, also known as a Variac. (Just as a ball point pen is often called a biro, even though Biro is a trade name.) The following letter is from a reader who wants to know how to fix such a device, and also how it works.

Can you help me with a problem with an old Variac autotransformer? I have a Warburton Franki (Sydney) 8A output unit which has developed an arc between two adjacent windings. How do I fix it? I am also curious about how this device works. Can you explain its operation, or point me to a suitable reference book on the subject? (Ian Paterson, email)

Before I explain how to fix it, first a few words about autotransformers. Basically, these have a single winding as shown in Fig.2. They can be step up or step down, and apart from offering no electrical isolation between the input and output voltages, they operate on the same principles as a conventional transformer. That is, the ratio of the input and output voltages equals the turns ratio; or Vin/Vout = n1/n2, where n1 is the number of 'primary' turns (Vin is applied across n1 turns), and n2 is the number of 'secondary' turns.

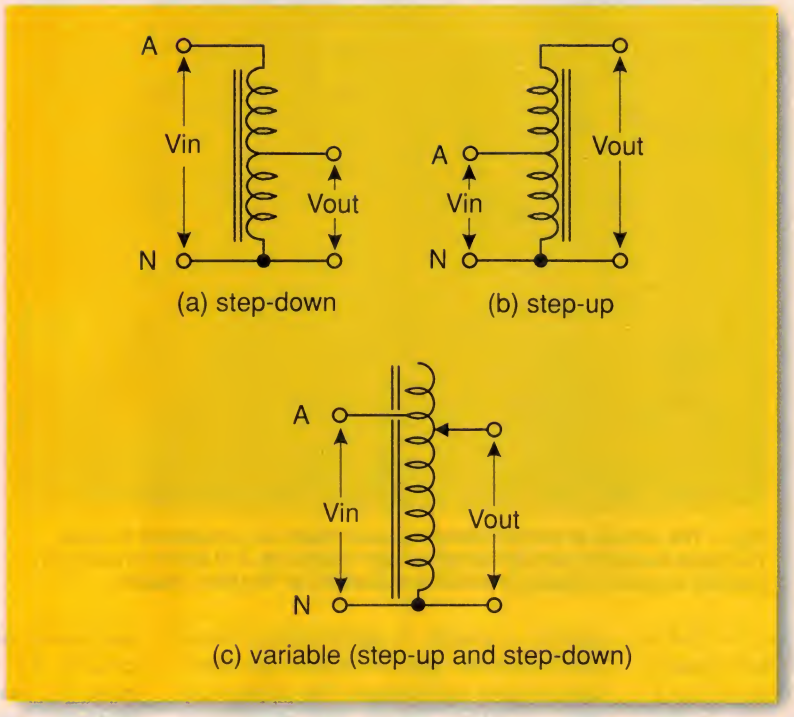


Fig.2: An autotransformer has one winding, as shown here, and can be configured to give a step-up, step-down or adjustable output.

In a variable autotransformer (Variac), the winding is wound on a cylindrical shaped iron core, with a moving contact touching the winding at the top of the cylinder. The insulation around the wires is removed at the point of contact, and the output voltage depends on the position of the moving contact relative to the common line (normally the neutral wire).

I built a Variac into a wooden box, with a double pole switch to swap the active and neutral inputs if required. I also fitted a neon indicator that lights if the active is connected to the common terminal, due to an incorrectly wired power outlet. This way, the common lead is always the neutral, an essential safety aspect when using a Variac. It's important to stress the safety aspects with a Variac, as there is no isolation between the mains (primary voltage) and the output voltage.

Repairing the windings is usually possible, providing the fault is accessible. You might find the problem is at the top of the winding, where the moving contact touches the wires. Try cleaning away any build-up of muck and dirt between windings, taking care not to damage the wire insulation. In some cases, it's necessary to remove damaged windings, replacing them with new wire of the same gauge, connected (soldered) to the remaining wiring at points away from the contact surface. Tricky, but possible. Most books about basic electricity cover the autotransformer, though perhaps not to the detail you might want Ian.

What??

I'm running seriously low on What?? questions, so here's my annual plea for more. The question I'm using this month was sent to me some years ago, and it sort of got lost in my files. It comes from Douglas Bolton (Mt Waverley, Vic), and is to do with the E24 range of resistors.

The E24 range of resistors has these (preferred) values: 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82 and 91. It's possible to derive many non-standard whole number resistance values by connected two E24 preferred values in series. Some can be formed in more than one way, eg. a value of 262Ω can be made from a 22Ω and a 240Ω resistor, or by using a 62Ω and a 200Ω resistor.

However, considering only the decade from 10 to 999, there is one resistance value that can be made up in seven different ways. Obviously its multiples of 10 will occur in higher decades. What is this resistance value?

Answer to November

The ages are 2, 2 and 9. There are eight possibilities that give a product of 36: 1,1,36; 1,2,18; 1,3,12; 1,4,9; 1,6,6; 2,2,9; 2,3,6; 3,3,4. As person X knows his own house number, and given that he needed more information, the only two possible solutions are 2,2,9 and 1,6,6 as both of these add up to 13. All other ages sum to a unique number, which clearly is not X's house number.

Given that there is an oldest child (with red hair), the solution must be 2,2,9 as the other solution (1,6,6) has two older children with the same age. The problem came from **http://www.the wizardofodds.com/math/**❖

New Books

PC Upgrade

BUILD AND UPGRADE YOUR OWN PC, by Ian Sinclair. Published by Butterworth Heinemann, 1999. Soft cover, 156 x 232mm, 206 pages. ISBN 0-7506-4267-X. Recommended retail price $65.

The back cover copy of this book asserts it be one "that computer retailers don't want you to read!" It further claims that "you can avoid the built-in obsolescence that seems to be part and parcel of the fast moving world of PCs, and escape the need to buy a new PC every year." And all you need to do is read this book. It's a slim volume, but given the wrap up, I could hardly wait to see what answers it came up with.

Unfortunately, while it's filled with lots of readable descriptions of PC architecture and add-ons, I seemed to have missed the bit that would tell me how I could avoid buying the next generation computer. Unless it's the bit that says "a home constructed machine is likely to be totally standard, more so than some big-name varieties, and (therefore) more adaptable to upgrading". What twaddle! I've used the same monitor, modem, keyboard and mouse for years, on some pretty weird machines.

But the part I really wanted to know about is the motherboard, as it's the part where technology changes are the greatest. Unfortunately, the author sees the computer case as being more important, giving it far more coverage than his description of the motherboard. So how about the section on disk drives? A whole chapter is devoted to these devices, however you need to go to another chapter to find out about such things as formatting and partitioning a hard disk using the DOS FDISK command.

There is a chapter on upgrading an old '386 or '486 PC with one page devoted to upgrading the motherboard. The main message here is to fit a new one!

So, this is not a book about future-proofing a computer, nor is it a book about upgrading. Instead it's a small book about IBM computers and their peripherals. It gives lots of background information, but this is all it gives.

The review copy came from Butterworth Heinemann, PO Box 146, Port Melbourne 3207. (P.P.)

Digital Video

DTV: THE REVOLUTION IN DIGITAL VIDEO, by Jerry Whitaker. Second edition 1999, published by McGraw-Hill. Hard covers, 243 x 192mm, 619 pages. ISBN 0-07-135021-7. RRP $140.

It's now abundantly clear that the future of

television and video will be almost exclusively in the digital domain. Which means that anyone wanting to remain active in the 'technical side' of these industries will need to become competent in digital video technology, if they're not already. Quite urgently now, too.

This book by highly experienced US engineer, editor and writer Jerry Whitaker would make a very good starting place, if you need to upgrade your skills and knowledge. It's just been updated and expanded for the second edition, and even more than before is likely to become an engineering classic. The author is a former radio station chief engineer, then editorial director and associate publisher of *Broadcast Engineering* and *Video Systems*, and has received various awards for editorial excellence and engineering education.

It's essentially a comprehensive technical reference on digital broadcast TV, video and HDTV. Starting with an excellent look at the development of TV systems and the progression to digital (The Road to DTV), it then moves on to cover imaging system principles, digital video coding, video and audio compression, HDTV production systems, DTV audio coding and decoding, the ATSC DTV system, DTV transmission issues, receiving systems and display devices, the European DVB standard, video measurement techniques and DTV implementation issues (one of the sections added for this edition). As you can sense from this it's quite global in outlook, and also gives a lot of references for further reading.

There's a huge amount of sound and valuable information on many aspects of this very timely and important subject. All the same, I confess I found some of the discussion on basic digital coding and compression concepts a bit sketchy and unsatisfying; for example if you didn't already know the basic idea of discrete cosine transformation (DCT), I really don't think that section will make much sense. On the other hand, there's a good insight into newer display devices like TI's digital micromirror device (DMD).

On the whole, it has to be recommended to anyone looking for a comprehensive reference to digital TV and video technology.

The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville NSW 2069. (J.R.)

Good reference

ELECTRONICS TOOLKIT, by Geoff Phillips. Published by Butterworth Heinemann, 1997. Soft cover, 156 x 234mm, 177 pages. ISBN: 0-7506-3790-0. Recommended retail price $40.

My first reaction after opening this book was "I want one". Here at last is a book that covers ground many technical people will be unsure of. It starts with the simplest of all components: the resistor.

For instance, what's the voltage rating of a Philips 1/4W carbon film resistor? It's 250V RMS according to this book, which goes on to tell you the voltage rating of virtually all types of resistors, along with a wealth of other useful and practical information about a component most books gloss over.

The same sort of practical information is given for capacitors and inductors, along with applications, formulae and rules of thumb. There are lots of tables, circuits and diagrams which make the information easy to find. As well, the author assumes the reader has a technical background and doesn't try and teach the basics. There are plenty of books that do that.

About half the book is devoted to semiconductors, where again you'll find information that is often difficult to source. As you'd expect, the book includes data for transistors, MOSFETs, triacs, op amp ICs, voltage regulators, and brief details of logic ICs. The listing is not complete, but certainly very useful.

Remaining chapters cover sensors and transducers such as thermistors and thermocouples; circuit configurations like a diode pump circuit, wheatstone bridge and so on; sound; light and heat.

The last chapter gives connection details, such as for a Scart connector, RS232C, even the pin connections of a few valves. This is certainly a most useful book for anyone involved in electronics, regardless of the level.

The review copy came from Butterworth Heinemann, PO Box 251, Port Melbourne 3207. (P.P.) ❖

Electronics Australia **is one of the longest-running technical magazines in the world. We started as *Wireless Weekly* in August 1922 and became *Radio and Hobbies in Australia* in April 1939. The title was changed to *Radio, Television and Hobbies* in February 1955 and finally, to *Electronics Australia* in April 1965.**

Here are some interesting items from past issues:

50 years ago

December 1949

New atom particle: A research team in the University of Rochester (New York) is on the trail of an atomic particle never captured before.

The researchers, doctors Julius Ashkin, Theodore Auerbach, and Robert Marshak, told a National Academy of Scientists' congress that they believed there was such a thing as a negatively charged proton.

United Press summed up the importance of this piece of research as "the possibility of more and better A-Bombs."

The atom is made up of negatively charged particles (electrons), which move around a nucleus consisting of positively charged protons, plus neutrons which have no charge at all.

Scientists have already found positive electrons. According to the Rochester team, there are also negative protons, which have a lifetime so short it may be only a faction of a second.

Once formed, a negative proton would be destroyed by the more abundant positive proton, a process which results in the forming of two of the mysterious particles called mesons.

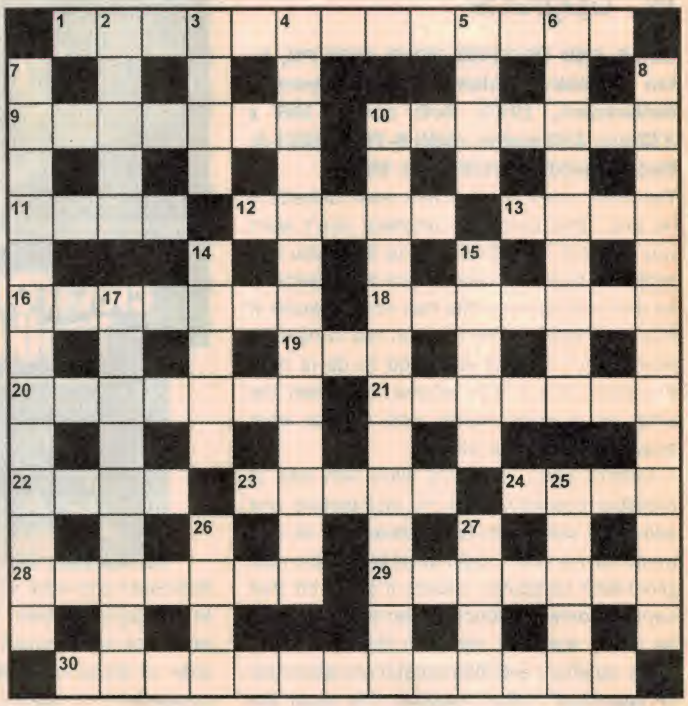
...25 years ago

December 1974

Long distance comms — via walkie-talkie: Downed pilots and survivors of shipwrecks may someday be able to call for help from any point on the globe with the aid of a tiny short-range radio, a collapsible antenna, and a space satellite.

The dramatic potential of space satellites for search-and-rescue missions was recently demonstrated by Roy Anderson, engineer at the General Electric Research and Development Centre, New York, when he beamed a message in Morse code more than 50,000 miles to an overhead satellite, using a modified 5W walkie-talkie and an antenna built upon the frame of a golfer's umbrella.❖

Crossword



ACROSS

1 This could be called a wireless set. (5,8)
9 Type of barometer. (7)
10 A reproduction of an original. (7)
11 Large screen system for movies.(4)
12 Inserts a cassette, etc. (5)
13 Inventor of an antenna type. (4)
16 One who determines the essential features. (7)
18 Sparks can do this to air. (7)
19 American Petroleum Institute. (1,1,1)
20 Passage of satellite. (7)
21 City of operatic barber. (7)
22 Fourth brightest star. (4)
23 Raises operational state. (4)
24 Electronic device. (4)
28 Those who conduct perfomance trials. (7)
29 Foretell. (7)
30 A former name of radar. (13)

DOWN

2 A field for contests. (5)
3 Widely-used metal. (4)
4 Broadcasting organisations. (5, 8)
5 International matchpoints in bridge. (4)
6 Said of extended crystal growth. (9)
7 Spontaneous disintegration of elements. (13)
8 These possess 7 down naturally. (13)
10 Said of certain elements with modified nucleus. (13)
14 Prefix meaning altitude. (5)
15 Find solution to a puzzle. (5)
17 Absence of sense of pain. (9)
25 Protein component, ____ acid. (5)
26 Metric prefix. (4)
27 Periodic fluctuation. (4) ❖

November's solution:

W	A	V	E	B	A	N	D		P	H	A	S	E	S
A		A		I		A		H		I		C		I
R	E	L	O	A	D	S		U	H	F	B	A	N	D
B		E		S		H		S		I		N		E
L	E	N	Z		B	U	L	B	S		K	N	O	B
E		C		S		A		A		D		E		A
	H	E	R	T	Z		A	N	S	W	E	R		N
J			O		P		D		A					D
A		C	O	P	P	E	R		A	R	R	A	Y	
Z		E		S		N		G		F		R		H
Z	E	R	O		S	T	E	E	L		R	I	F	F
B		A		B		O		M		I		E		B
A	R	M	B	A	N	D		I	N	E	R	T	I	A
N		I		U		E		N		E		T		N
D	E	C	O	D	E		W	I	D	E	B	A	N	D

Electronics Australia's

Professional Electronics

Touchscreen Technology

Video Microscope

Ericsson's 10 millionth DC/DC converter

A Pioneer on the Cisco Trail

Quantum's new LANvault does remote site 'box to backup' in minutes

Travelstar E gives 10GB portable storage via PC-Card interface

HIGHLIGHTS

Finally... The winners of the 'A Stamp for your thoughts' competition.

Back in the May issue of Electronics Australia we invited readers to send us their original and interesting ideas for using a Basic Stamp microcontroller module. We had a great response, but it has taken a while for the entries to pass through our judging process, which involved EA, Stamp distributor RTN, plus the US-based Basic Stamp creators, Parallax.

All of the entries have now been processed, and while it wasn't an easy decision, we're pleased to announce the three winners of these great Basic Stamp products, which have been generously donated by RTN.

First prize: Mike Paull, who wins a full version of RTN's BS2 development board, an LCD interface kit, V1.9 Stamp user manual, plus a serial programming cable and matching software.

Second prize: Ian Mitchell, who wins a 'skeleton' version of the BS2 development board, an LCD interface kit, plus a serial programming cable and matching software.

Third prize: Michael Gempton, who wins a solderless prototyping breadboard with BS1 module, a parallel programming cable and matching software.

Congratulations to all the winners!

IBM Creates Spray-On Transistors

Researchers at IBM said that they have created a thin, flexible type of transistor that could one day be used to make a computer screen that could be rolled up.

The invention is inexpensive and can be sprayed onto plastic, making it useful in a variety of areas, they said.

"We are talking about a new class of materials for transistors," says Cherie Kagan, a materials scientists at IBM in Yorktown Heights, New York, who led the study.

The transistors are made of very thin layers of materials that can be laid down onto plastic. "You might be able to build devices on something that is flexible," Kagan says.

Transistors currently are made out of materials that are processed at very high temperatures, meaning that they must go onto hard, unmeltable surfaces.

"The display on your laptop is silicon and requires much higher temperatures," Kagan says. "Plastic couldn't stand up to those temperatures. You would just obliterate the thing."

Writing in the journal Science, Kagan and her colleagues describe their technique, which uses layers of organic and inorganic chemicals. "We can take these materials, put them in solution and spin-coat them. The idea is that [the process] is low cost and possible to do at room temperature."

"This approach is a pretty radical idea for the industry, but it makes perfect sense to a chemist," she added.

Lone Leann pioneers the Cisco trail

Leann Crawford of Wheelers Hill is one of the rare women who is 'networked' and ready to go in the competitive industry of Information Technology. Leann was among the first students to graduate on October the ninth from the Cisco Systems Networking Academy program at the Australasian Cisco Academy Training Centre, at Box Hill Institute. Apart from being in the first course to graduate from the Training Centre, Leann was also the only woman in the course – a situation replicated in computer courses across the country and the world.

A recent study by Sydney University of Technology found that fewer than 20 per cent of computing students were female, and in some IT courses females comprised as few as 12 per cent. "I must admit I didn't realise the gender imbalance before I got into it," Leann said, stating that she had become used to being the only woman in the group. "Sometimes it is a bit difficult, but the guys I work with treat me very well."

Leann said it was the need to keep up to date, particularly with networking and the benefits of certification that caused her to join the Cisco Systems Networking Academy Program. She now hopes to continue on, and complete the Cisco Certified Networking Professional course.

Further information about the Cisco courses on offer at Box Hill Institute are available from Henry Wiebell on 9286 9861.

Power Mac G4 banned in Hong Kong

Apple Computer's Power Mac G4, touted as the first personal computer to deliver supercomputer-level performance, arrived in Hong Kong last week. But it won't be allowed to cross the border without a license, due to U.S. government national security restrictions on the export of high-speed machines.

Under U.S. regulations, the Mainland, together with Israel, Russia, Pakistan and 45 other countries, belongs to the so-called Tier III category, meaning that computers performing at over 2,000 MTOPS (millions of theoretical operations per second) are prohibited from being exported to those countries without a license from the U.S. government.

The newly-introduced 450MHz Power Mac G4 has a processing power of 2,775 MTOPS and therefore will not be sold on the Mainland, confirmed Tony Li, Apple's Hong Kong-based marketing director.

As a means of preventing customers from shipping the machine to the Mainland by mistake, the G4 carton is being labeled with the following warning: "The G4 computer in this box is for use in Special Administrative Region of Hong Kong only. Export to the People's Republic of China is prohibited by law."

Li noted, however, that it is legal for subsidiaries or branch offices of Mainland companies located in Hong Kong to purchase the G4 for use in the SAR. And he indicated that

whether the machine is ultimately shipped to the Mainland is not Apple's problem. "This depends on the watchful eyes of the Customs and Excise Department," he said.

Safety Notice and Recall for the Fluke T2 Tester

Fluke Australia have announced a potential product malfunction in the Fluke T2 Electrical Tester. This notice includes all T2 units manufactured and shipped before September 1999, with serial numbers lower than 74165430. The safety notice includes the T2 instruments involved in a previous safety notice dated November 1998.

The T2's positive battery contact can corrode over time due to exposure to vibration. In certain situations, the instrument can operate intermittently - sometimes it will turn on and sometimes not. When the malfunction occurs, the tester may not indicate that voltage is present, placing the user in a potentially hazardous situation.

T2 owners are directed to stop using their T2 Electrical Testers as soon as possible even if they have not experienced this problem.

Owners of units that have serial numbers between 70521601 and 74165430 have two options. They can either request a free Field Repair Kit containing a new battery contact coil spring, two new AA-size zinc-oxide batteries and self installation directions, or they can return their T2 Tester to Fluke Australia for repair.

Customers are urged to email david.mayhew@fluke.com.au or fax their request for a Field Repair Kit to (02) 8850 3300 as soon as possible. If required, telephone (02)8850 3333. To return a T2 Tester, send it with a Safety Notice Return Form (available by faxing Fluke Australia (02) 8850 3300) to; Fluke Australia, 26/7 Anella Avenue, Castle Hill, NSW 2154.

If the T2 owner' s unit was affected by the November 1998 safety notice, with a serial number lower than 70521601 and it does not have an "R" stamped after the serial number, the T2 was not repaired in the November 1998 recall. The unit now MUST be returned to Fluke for repair.

Powerhouse store for Nunawading

Australian retailer Dick Smith Electronics, will open its fifth PowerHouse store in Nunawading (Melbourne) on 25 October 1999, following the success of its four stores at Bankstown, Penrith and Moore Park in NSW, and Carnegie in Victoria. The store is situated amongst other homemaker retail outlets on Whitehorse Road, Nunawading, covers 2,000 square metres (about six times the size of an average Dick Smith Electronics store) and features over 30,000 products in its range.

"We are pleased to be part of this important homemaker retail precinct in the heart of Melbourne's eastern suburbs," said Jeff Grover, Managing Director of Dick Smith Electronics. "The PowerHouse concept focuses on the convergence of consumer technology in the Australian community. "Everything at a Dick Smith Electronics PowerHouse is plugged in, powered up and fully tuned for our customers to try out.

Ericsson ships world record 10 million PKF DC/DC power modules

Ericsson Energy Systems has announced that its MacroDensTM line of DC/DC power modules has passed the landmark of 10,000,000 units shipped. This is believed to represent the highest volume for any single family of isolated DC/DC converters ever delivered. The innovative MacroDens line broke new ground when it was launched in 1993, with a proprietary smart-power IC and thick film technology providing an extremely high level of integration. This was combined with IC-style over-molding to achieve a unique solution for volume assembly. Tape and reel packaging, a weight of less than 20g, and a guaranteed co-planarity of 0.1mm have proved major factors in achieving compound growth of more than 50% per year for the last five years, together with a rapidly expanding family now totaling 18 different models, with each in two mechanical versions; SMD and through-hole.

The introduction of 24 V, 48 V and wide-range input versions, as well as a comprehensive range of single and double output models has fuelled growth, which has seen the average shipments for two weeks in 1999 equivalent to the total for the first two years of production. The PKF is now manufactured in two plants using three separate automated production lines, ensuring security of supply and enabling volumes to continue to grow strongly. Ongoing innovation such as a doubling of the output power, the provision of tape and reel packaging, and the unparalleled MTBF demonstrated in real applications has pushed 1999 demand more than 60% higher than 1998. ❖

SOLID STATE Update

LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Ultra low profile DC/DC power module

Ericsson Energy Systems has launched a new family of DC/DC power modules with the ultra low profile PKN series, utilising patented techniques with synchronous rectification to achieve >90% efficiency between 30% and 100% of full load. The high efficiency and good thermal management mean that the PKN delivers full power without a heatsink up to 80°C ambient with only 1m/s airflow.

The ceramic substrate, thick film technology and planar magnetics achieve an ultra low profile 8.5mm height, enabling its use with very high density board spacings down to 15mm. This construction also contributes to the extremely low weight of only 40gm, and the high reliability of more than 200 years MTBF at 75°C case temperature. The converter also features a number of advanced control and alarm functions, not normally available in DC/DC converters.

The first model in the 48V/60V input PKN series is the PKN 4510 PI, which offers 3.3V at 15A. 100% testing and automated laser adjustment provides accurate voltage setting within +20mV, with 2mV line regulation and 10mV load regulation from 1% to 100% of full load ensuring that voltages are tightly controlled even under worst case conditions. In addition to the usual input undervoltage and over-temperature shutdown, the module includes remote on-off control, which is open collector TTL compatible. In addition, any undervoltage on the output, however caused, will trigger the protection circuitry, shut down the module and issue an alarm signal. This alarm signal is available for remote monitoring, and can source up to 70mA.

For more information visit Ericsson's web site at **www.ericsson.com/energy**.

Integrated SMT resistor networks

Philips Components' Advanced Ceramics & Modules (AC&M) business group has announced the introduction of a new space-saving 8-resistor bussed network for signal matching on computer motherboards. By taking up less space than discrete products, the new networks will free up board space for additional functions and greatly simplify layout and assembly procedures.

The new network is in a 10-pin 1206 case with two ground connections. It takes up only about 40% of the board space required by a network based on a discrete 0603 resistors, freeing up valuable board space that designers can use for reducing circuit size or increasing the functionality of their designs. The network is even small enough to fit beneath the processor IC itself, allowing for further savings in board space and improvements in reliability since interconnections are then much shorter.

For more information contact Philips Advanced Ceramics & Modules, Marketing Communications, Building TQIII-3, P.O. Box 218, 5600 MD, Eindhoven, The Netherlands.

1A, 600kHz Boost Switcher

Linear Technology has introduced the LT1949, a step-up PWM DC/DC converter capable of generating high voltage, low noise bias voltages required by large thin-film transistor (TFT) LCD panels. The LT1949 includes a 1A, 30V internal switch that produces output voltages up to 28V using a single low-profile inductor. Its 600kHz fixed frequency operation delivers very low output ripple that is easy to filter, thus minimising noise in sensitive applications.

The LT1949 includes an external loop compensation pin that gives a user the ability to optimise feedback loop performance and permits use of small, low ESR ceramic capacitors. The LT1949 also helps reduce design size with its compact MSOP-8 package as well as with its high switching frequency that allows use of smaller magnetics compared with lower frequency parts. The LT1949 incorporates a low-battery detector that stays alive when the device goes into applications. The LT1949 also provides a pin-compatible upgrade for the LT1317B boost converter for applications that require up to 33% higher current (1A vs 750mA).

For more information contact REC Electronics, Unit 1, 38 South Street, Rydalmere NSW 2116.

8051 processor with dual CAN controllers

Dallas Semiconductors has announced the DS80C390 Dual CAN High-Speed Microprocessor. Its the first high-performance 8051 processor to integrate two CAN (Controller Area Network) bus controllers with a host of peripherals, and at the same time break the previous memory barrier by addressing 4MB of external data memory and 4MB of external program memory.

By integrating two CAN controllers, the DS80C390 meets a growing demand for CAN's wiring simplicity and robust data integrity in embedded systems. CAN circuitry is being used in factory automation, marine control and navigation, industrial control systems, and HVAC control. CAN protocol, a 1-Mbit/second serial standard, enables multiple devices to communicate in real time along a simple bus medium in high-noise environments. All error detection/correction, transmission and reception are carried out in hardware by the CAN controllers. By integrating two CAN controllers, the DS80C390 can host more devices and, since they can communicate transparently with each other, provide back-up redundancy.

As a full-featured microcontroller, the DS80C390 uses high-level integration to drastically reduce a system's component count and therefore its costs. Besides standard 8051 resources — three timer/counters, serial port, and four 8-bit I/O ports-the DS80C390 integrates an additional 8-bit I/O port, a second serial port, seven additional interrupts, programmable watchdog timer, brownout monitor/interrupt, powerfail reset, and a programmable IrDA clock. In addition, 4 kilobytes of on-chip SRAM can be flexibly configured in various combinations of memory functions. ❖

DSE's kit for our Brick Amp

The popularity of 'The Brick', our compact add-on stereo/mono amplifier for surround sound systems should be enhanced considerably, as a result of Dick Smith Electronics releasing this impressive kit. Here's a rundown on its features, from the project's designer.

by Jim Rowe

WHEN I DEVELOPED the little Brick amplifier, described in the June issue, the idea was to produce a very compact, low cost two-channel amplifier which could be used to add extra power amp channels for those who (like me) were expanding their existing stereo or home theatre systems for digital surround sound. And in keeping with this concept, I managed to cram everything into a standard low-cost aluminium utility box. It was a very tight squeeze, though, and I confess the result could really only be described as 'starkly functional'.

The good news, for anyone thinking of building one or more Bricks, is that in coming up with their kit for the design, Dick Smith Electronics has gone 'one step further' and had a custom box made. This has allowed them to make it about 6mm deeper and 12mm wider — just enough to make it easier to assemble, and significantly better looking. The case is also made of steel, so it's stronger than the original, and they've designed it so the sides of the lid fit *outside* the flanges on the bottom, for neatness.

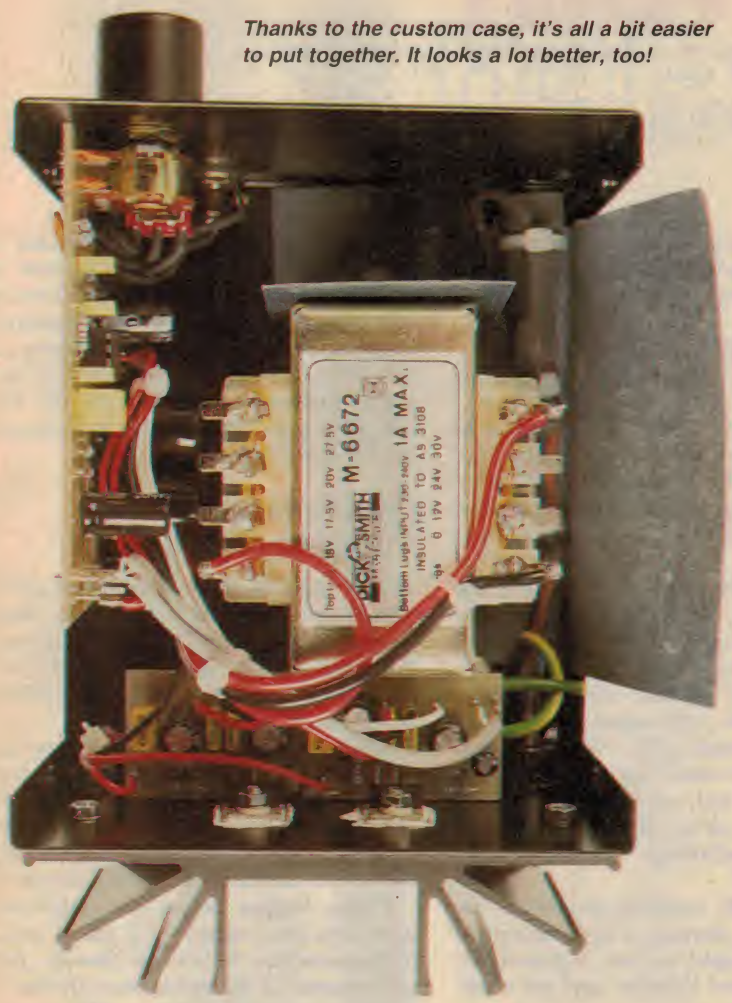
Not only that, but the case bottom is fitted with captive nuts, so the two halves can be assembled using M3 machine screws rather than the self-tappers used in the original. And the metalwork is finished in a durable black hammertone powder-coat, with crisp silk-screened white legends on the front and matching black M3 screws provided. So there's no doubt that if you build *this* version of the Brick, it'll not only be easier to put together, but also much better looking and more durable than my original.

Inside the case, there's further evidence of DSE having put a great deal of care into ensuring that their kit will make up into a safe and reliable amplifier. There's heatshrink sleeving provided not only for the basic mains connections, but also for the wiring from the rear of the stereo/mono switch and input RCA connectors to the PCB — plus a length of large-diameter sleeving as well, to enclose the complete rear of the fuseholder.

Just to make sure, when it comes to user safety, they've also thrown in two sizeable pieces of 'Elephantide' fireproof insulating sheet, to make protective flaps along the front and left-hand side of the power transformer. And there's also nine nylon cable ties, to allow you to group the various wires neatly and safely.

To make sure that even inexperienced constructors can 'do the right thing', DSE has also expanded my original article into a comprehensive 12-page Kit Assembly Manual, with a raft of additional pictures and diagrams. These include a complete detailed wiring diagram, showing all earthing lugs, cable ties etc; template diagrams and drawings showing how to cut and fit the Elephantide flaps and drilling the finned heatsink; and detail drawings for the switch and fuseholder wiring and sleeving, power transformer mounting and earthing, mains earth lug and power IC mounting. There's also guide tables showing screw, nut and lockwasher allocation, and also the correct wire or cable to use for each connection, plus various close-up photos to provide additional guidance during assembly. Oh — and resistor and capacitor marking codes, too.

Other nice features of the kit include very cleanly etched and solder plated PCBs, a socket for the TL072 dual op-amp IC, and even the additional components I suggested to ensure stability and minimum hum: the two additional 56pF capacitors, and the 10k resistor between signal and mains earths. The



Thanks to the custom case, it's all a bit easier to put together. It looks a lot better, too!

manual shows clearly where these go, as well.

As you can see from the photo, DSE's Kit Department sent a fully assembled example of their kit, for me to examine. As well as doing so I was able to run the instruments over it quickly, to check its performance. There were no problems here, either; the performance compared very well with the original. In fact it was a little better than the original in a couple of areas: channel crosstalk at full output measured -53dB or better at both 1kHz and 100Hz (compared with about -43dB), while signal to noise ratio was just on 80dB unweighted compared with 71dB.

So overall, the Dick Smith Electronics kit and assembly manual for the Brick are both of a very high standard indeed. About the only tiny criticism I could make was that the bottom corners of the case lid hadn't been rounded, to prevent the possibility of cuts or scratches from the sharp corners.

But this is a minor niggle; there's no denying that the DSE kit would be an excellent choice if you're proposing to build one or two Bricks to expand your surround sound or home theatre setup. I'm more than happy to give it 'the designer's blessing'. ❖

DSE's Brick Amp Kit

A complete and nicely presented kit for our June 1999 Brick Amplifier, delivering a nominal 15W/channel in stereo mode or 28W in bridged mono mode.

Good Points: Improved steel case, well finished and with captive M3 nuts for easier assembly; Elephatide sheet and nylon cable ties for greater safety; comprehensive, very helpful assembly manual.

Weak Points: Very little. Rounding the bottom corners of the case lid would have prevented cuts and scratches.

RRP: $93.50

Available: From Dick Smith Electronics stores and dealers, also via the Direct Link service. Kit catalog number is K 5609.

Silicon Valley Newsletter

Lucent developing electronic paper

THE SUNDAY NEWSPAPERS in most American cities measure several hundred pages, not counting dozens of catalogs and other advertising inserts. If Lucent Technologies' plans succeed, that may all be reduced to a single page. Lucent's Bell Labs research operations and E Ink have announced their engineers have teamed up to refine E Ink's 'electronic ink' technology that is used in highway billboards and other large signs.

Their goal is to develop a new low-cost 'electronic paper', which they envision as flexible plastic sheets that would electronically display text and images. The electronic paper could increase the market for paperless books, magazines and — eventually — newspapers.

The immediate application of electronic paper will be in replacing existing liquid crystal displays in various existing applications, including computer displays.

Another major opportunity lies in the area of electronic books, which are becoming more popular. US book retailer Barnes & Noble recently announcing plans to sell an electronic book system from NuvoMedia. Lucent's electronic paper technology could make the books much lighter, thinner, cheaper and less power consuming. "Our goal is to make a paper-like film that is as flexible and easy to read as ink on paper", said Pierre Wiltzius, a researcher with Bell Labs.

The electronic paper will use new plastic transistors developed by Bell Labs to transmit the electronic signals that create the image on the screen, a technology developed by E Ink. The plastic transistors are far less costly to produce than the silicon based transistors used in current LCD displays.

E Ink's screen is comprised of millions of tiny micro-capsules filled with a dark dye and light pigment. When charged by the electric field created by the plastic transistors, the micro-capsules change colour and create images, which remain on the screen even after power is turned off or until the user replaces it with another image.

Xerox and 3M also recently announced an alliance to bring Xerox's electronic paper technology out of the lab and into the market.

E Ink and Lucent hope to have a prototype developed within a year and commercially available products shortly thereafter. "As we learn to manufacture higher performance systems, we could move to electronic books", said Paul Drzaic, director of E Ink's display technology division.

Dell & Samsung ink US$5.8B FPD deal

IN A MOVE APPARENTLY designed to avoid the problem of a global shortage of flat panel displays, Dell Computer has signed a massive five-year FPD supply contract with Samsung Electronics. The deal is valued at US$5.8 billion. As part of the contract, Dell is buying $200 million in convertible Samsung bonds, which the company has the option of exchanging for about 1% of Samsung's common stock.

Samsung will use the cash influx from Dell to boost its FPD output for notebook computers and desktop PC. "We believe that these agreements make us a preferred partner of Samsung's, and will provide us with a massive stream of LCDs based on leading-edge display technology", said Dell CEO Michael Dell.

Worldwide PC notebook production has been hurt by a shortage of key components used to make display screens, a general lack of overall screen supplies, and the earthquake in Taiwan.

Samsung is expected to sell US$2.1 billion worth of FPDs in 1999, up from $850 million in 1998. Samsung's output is expected to reach 480,000 13.3" TFT-LCDs a month by the end of this year and 700,000 per month next year. A new plant will begin operation in 2001 and will be capable of making six 17" TFT-LCDs from one 730 x 920mm substrate. Analysts said it will be the first attempt to use a substrate that large to produce TFT-LCDs.

Intel & Nokia in TV set-top deal

INTEL SAYS IT HAS signed a joint development agreement with mobile phone maker Nokia Oyj, to make television set-top boxes that combine features of the Internet with broadcast TV. The new set-top box will run on Celeron-based processors.

Nokia, based in Finland, already makes a line of set-top boxes. The alliance with Intel will enable Nokia to enhance the Internet access capabilities of the boxes. For Intel, the set-top box market represent a new and vast market for its microprocessor technology.

Putting Internet access into telephones, televisions and automobiles is one of Intel's highest priorities, said Ganesh Moorthy, general manager of the applications division in Intel's home products group. "We want to extend the Internet into every part of the home."

IBM's new Travelstar E is a compact 10GB hard disk drive in a rugged case and fitted with a cable to plug into a standard PC Card slot. It needs no separate power cable, and comes with software to allow mobile PC users to use it for storing music as well as data. It's currently selling for around US$550. (Business Wire photo)

Solectron teams up with Acer

ALREADY THE WORLD'S largest high-tech contract manufacturer, Solectron of Milpitas is adding powerful new system design capabilities to its array of contract services. The company said it has struck an alliance with Taiwan's Acer, in which the latter will provide design capabilities to Solectron.

The design capability will allow original equipment manufacturers (OEMs) to use Solectron to contract out every step of the manufacturing of a personal computer, workstation or a computer server, from design to manufacture to repair.

Hitachi to build a new FPD plant

EAGER TO KEEP up with Korea's Samsung, Hitachi is investing an additional US$322.5 million to build a new LCD-based flat panel display manufacturing facility in Chiba near Tokyo. The new plant is likely to come on line next year and will double the company's LCD production capacity.

Meanwhile, Hitachi is conserving some of its resources by contracting out the production of its of microprocessors and other ICs to United Microelectronics Corp. (UMC) and Episil Technologies of Taiwan.

Demand for LCD panels is rising for use in personal computers, laptops, television sets and mobile communications equipment.

PC prices on the rise

WHEN WAS THE last time personal computer prices rose? 1996? 1994? You have to go back to 1993, when 33MHz 80486 PCs and 1 megabit DRAMs were in vogue, and the World Wide Web was still mostly a lab experiment.

The catalyst for the sudden hike in PC prices has been the Taiwan earthquake, which brought IC and PC motherboard production to a grinding halt for nearly two weeks. But pressures on PC component prices had already been building up.

Now, price hikes of 25% or more in system memory chips are causing companies like Dell Computer to cut back on DRAM in their computers in order to avoid having to raise prices. Dell said that its memory costs have gone up about 25%, adding about US$40 in costs per PC for standard configurations. Apple Computer essentially did the same thing by putting less powerful G4 processors into its new G4 Macintoshes.

The net effect, however — less bang for the buck — marks a major reversal from a trend that has caused average PC prices to fall from more than US$2000 to less than $900 in the last four years. Prices for 64 megabit DRAMs, for example have jumped on the spot market from $5 in June to $20. As Taiwanese production has resumed, those prices have fallen back to about $13. Strong laptop sales have also pushed up prices for the liquid crystal displays by $100 to $200.

"For the first time in years, consumers will probably be better off buying systems now rather than waiting for prices to drop some more, because the computer you buy this month is probably going to cost more next month", said Nathan Brookwood, founder of Insight 64, a market research firm based in Silicon Valley.

IBM pulls out of US PC retail market

NOT SINCE THE company dumped the PCjr and its market-leading PC-AT platform in the mid- and late 1980s has IBM made as dramatic a move in the personal computer sector as when the company announced it is pulling its computers off US computer retail store shelves and will no longer market PCs through the highly competitive channel.

IBM hopes to have vacated all US computer retail stores in the first quarter of 2000. Instead, it is pushing online sales as the main marketing vehicle for its personal computer systems sold to consumers and businesses.

IBM's retail systems are sold under the Aptiva brand name. An IBM spokeswoman said the company may eventually return to the retail market if it can find a way to actually make some money by selling there. Retail sales are expensive, due to the high advertising support requirements most major retailers impose to support efforts to draw customers to their stores. Because intense competition from from companies such as eMachines, traditional vendors like IBM are often losing money on their retail sales.

"We plan to pull Aptivas out of the retail channel in the US", spokeswoman Trink Guarino said. "Once we come up with a formula that works, we will be back."

Jury says Motorola infringed PI patent...

MOTOROLA MAY HAVE to pay US$96.9 million in penalties to Sunnyvale firm Power Integrations, for infringing on a PI power chip patent that converts 110-volt alternating current to low-voltage direct current for cellphone chargers. After a two-week trial, a nine person jury sided with PI and awarded the company US$32.3 million for infringing its 1994 patent. Presiding Judge Joseph Farnan Jr could triple the award to $96.9 million because the jury said the infringement was intentional.

"We're gratified that the jury saw things our way", said PI lawyer Frank Scherkenbach. "Motorola has exactly every element contained in the patent."

Motorola has denied copying PI's patented product and said it may appeal the decision. "We're extremely disappointed and surprised at the verdict", said William Seiferth, a Motorola spokesman. ❖

Britannica goes online — free!

IT IS THE OLDEST continuously published reference work in the English language, and for the past 231 years door-to-door salesmen have made careers out of selling the *Encyclopaedia Britannica* to consumers by urging parents to put the world's knowledge on the home bookshelf with easy monthly payments. Now the entire US$1250 32-volume product is available on the Internet — for free.

The Encyclopaedia Britannica has been in trouble since the rise of the personal computer in the consumer market and the competition from low-cost CD-ROM based encyclopaedias. The company was too late in the market for CD-ROM products to make an impact.

While the company intends to continue marketing a 40-volume printed version, it hopes revenues from selling advertising space on its Web site will revitalize the financial performance of the company.

"This is a momentous day for knowledge seekers everywhere", said Don Yannias, chief executive of Britannica.com, a new company owned by the publisher and named for the Internet site that carries the material. "Purchasing Encyclopaedia Britannica was once a major milestone in a family's life, but today we are fulfilling our promise to make it more accessible to more people worldwide. Now everyone with access to the Internet can use Britannica.com as they wish, not only for the encyclopedia, but for the top-quality information and services we offer", Yannias added.

In addition to the full text of Britannica, the site features news feeds from newspapers and news wires around the world; selected articles from more than 70 popular magazines including *Esquire*, *Sports Illustrated* and *The Economist*; and a searchable directory of Web sites chosen by Britannica's editors.

Britannica, the brainchild of three Scotsmen, issued its first edition in 100 parts from 1768 to 1771 in Edinburgh, Scotland. The company came under US ownership in 1901 and was later acquired by Chicago-based Sears, Roebuck and Co. In the 1940s it was bought by William Benton. In 1995 the company, after losing money for several years, was sold to an investment group led by Swiss businessman Jacob Safra for an estimated US$500 million.

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Spectrum Analyser Systron Donner Model 762-2A 10 MHz- 40GHz. Don't know if it works properly but the CRT display shows something plausible! Includes service manual $500.00 (02) 4751 1127

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Construction Project

Black Box for Blinking Lights

(Continued from page 47)

Testing & setup

Once your unit is assembled, it's time for testing and setup adjustment. You can do this with the lid left temporarily off the box — but be careful, and make sure you don't come into contact with the triac heatsink tabs.

First of all, set the two preset pots (RV1 and RV2) to mid range, and set the fast/slow switch to 'slow' (wires connected, to include C7 in circuit). Then plug the mains cord into a suitable power point and switch on. The two LEDs on the board should immediately begin blinking in apparently 'random' fashion, varying from 'dark' to 'dim' to 'bright' at varying speeds. If all's well you should be able to switch SW1 to the 'fast' position and see these actions proceed somewhat faster.

If the LEDs don't glow at all, or stay on, or something else seems amiss, immediately turn off and remove the mains power to investigate. You've probably made a wiring error, so go over everything carefully and seek out the reversed or swapped component(s) — like swapped PNP and NPN transistors. With a bit of luck, they won't have been damaged and you'll be rewarded with correct operation when you try turning on again.

Assuming everything does seem OK so far, all that remains is to set RV1 and RV2 for the right 'dim' level in each channel. To do this, plug a suitable lamp load into each output socket. It doesn't have to be the final Christmas lamp loads; a couple of table lamps will do.

Now, setting SW1 for 'slow' to make things easier, it's a matter of adjusting RV1 and RV2 as necessary, to set the 'dim' current level correctly for each lamp. This is done purely 'by eye', adjusting each pot until the lamp for that channel glows dimly but reliably, every time that channel's LED is also glowing dimly.

This can be a bit fiddly, and the correct setting tends to vary a little with temperature, so you may need to 'tweak' the adjustments slightly after everything has warmed up. But finding the correct setting isn't hard; if you have the pot set too low (anticlockwise) the lamp may not come on at all when its LED is glowing dimly, but flash only when it's bright. On the other hand if you have it set too high (clockwise), the lamp may glow brightly even when its LED is glowing dimly. The correct setting is clearly between these two extremes.

Once the pots are set correctly, your Light Blinker is finished and the lid can be fitted to the box, to ensure its safety and yours. It should then be ready for doing its blinking job! ❖

SERVICEMAN

(Continued from page 59)

seen at each end of the micro's earth plane strap. This looked like the lucky break I'd hoped for. After resoldering the strap properly, a 0V earth was restored to the micro, CD's played normally and a friend was very grateful.

This exercise does reinforce again that integrated circuit chips are, in general, more reliable than the bits that connect them together. I do agree, Bill. And Peter Fox will also agree, I'm sure. It's just amazing the number of 'faulty' devices that eventually prove to be no more than dry joints or bad connections. I can't remember many of those sort of problems with the old 'point-to-point' wiring.

It might be that those old joints were made with a 100 watt iron onto galvanised iron chassis. That sort of technology is not conducive to dry joints. The odd faulty joint that did occur was usually attributable to corrosion and not to thermal effects as are the modern ones.

And as for dicey sockets, there weren't all that many in a 5 valve radio! A few more in a valve TV, but even with miniature valves, the sockets utilised relatively large metal to metal contacts. So the convenience of printed wiring boards has brought with it a penalty - dry joints and extra sockets. You can't win, can you?

Remotes and fluoros

Now for another short item before we close this month's column. In the June column I reported on a very strange reaction between an IR remote control and a compact fluorescent lamp. If you remember, the remocon would not work while ever the lamp was on. In summing up, I commented that I (and my colleagues) had never heard of a similar problem.

Well, a reader from the N.T. has come back with a report that parallels my friend's experience. The reader is Alan Howard, of Darwin, and he writes...

"I have had some units do very erratic things due to compact fluoro lights. One customer had their stereo and TV go haywire every time they turned their lights on. The stereo would change volume, input selection etc., while the TV would randomly change channels."

So there we have it. Compact fluoros CAN upset IR remote controls! The phenomenon is apparently not common, but it does happen occasionally. It would be interesting to know by what process the interference occurs. As Editor Jim Rowe commented in the June column, it's probably a combination of the inverter frequency and excessive IR radiation. Although I wasn't aware that fluoros actually emitted much IR - I thought they gave off more UV. Maybe compact fluoros are different. Anyway, it's something to remember next time you are confronted with erratic remocon operations. That's it for now. There'll be more next month, I hope.❖

COMPUTER NEWS & New Products

64-bit VMEbus chassis

VME64x represents future-proof expansion of the Knurr VMEbus based on 64-bit data and address width. It requires a new backplane design and upgrades in enclosure structure as defined in the IEEE 1101.10 standard. These upgrades are integrated in the Ricon VME64x system chassis.

The monolithic structure of the 21-slot backplane with 5-row connectors in the P1 and P2 level also permit installation of conventional Knurr VMEbus daughter cards with three-row connectors. Input/output signals are transmitted through the metric 95-pole connectors.

The enclosure structure of the system chassis conforms with IEEE 1101.10. New push/pull tools with long lever ratios reduce the forces required and permit boards with high-pole connectors to be pushed and pulled with minimum effort. 21 daughter cards (6 U/4 HP) can be installed at the front. Up to 12 I/O modules or 6 U/4 HP front-panel sections guarantee modular input/output structure on the system rear side.

High EMC protection already integrated in the standard modular chassis is complemented by EMC front-panel sections with front-shielding function. ESD springs protect the system against static charges.

For more information contact Ricon, Unit 1, 32 Lilian Fowler Place, Marrickville NSW 2204.

LAN outlet identifier

The LanMaster 30 Outlet Identifier is designed to quickly identify the type of network or telephone connections present on the RJ-45 jacks of a wall outlet. It will identify a 10baseT Link, 100baseTX Link, Token Ring Link, Analog Telephone Line, PBX Line or an ISDN Line. The unit will also warn the user if unidentified signals are present at the jack or if the jack is not connected.

Its an essential tool for any user responsible for managing, installing or maintaining network or telecom systems. Connecting equipment to an untested wall outlet can damage the installed device if the outlet does not have a compatible electrical interface.

The LanMaster 30 scans all eight wires connected to an RJ-45 outlet to identify the type of system connected or the presence of potentially harmful unknown signals. Identifying outlet connections with the Model 30 eliminates guessing at which is the correct outlet or wasting time tracing cables.

For more information contact Cable Check, Suite 703, 225 Clarence Street, Sydney 2000 or call 1800 653 106.

Fast 1200dpi desktop scanner

Canon Australia has launched the CanoScan FB1200S flatbed scanner, which incorporates a unique optical glass and lens system known as 'VAROS' to attain high optical resolutions. The FB1200S scanner also incorporates a SCSI interface in order to ensure fast and reliable data transfer.

The key to the high resolution of the FB1200S is 'VAROS', which stands for Variable Refraction Optical System. This system allows a 600dpi CCD sensor to 'see' 1200dpi optical resolution by using a moveable optical glass to shift the vision of the CCD sensor by half a pixel, creating a second view of the subject. The TWAIN driver then interlaces these two views to create a 1200 x 1200dpi optical image.

The FB1200S has 12 bit per colour channel sampling, which equates to 4096 gradations per colour channel for each of red, green and blue. This allows it to deliver colour faithful scans with over 68 billion colours.

To handle the complexity and size of 36-bit data files, Canon includes a copy of Adobe Photoshop 5.0LE, a feature reduced version

of the industry standard in professional image editing.

The CanoScan FB1200S is fast. Users can scan an A4 full colour page at 300dpi in around 60 seconds. The SCSI interface ensures reliable and high-speed data transmission while Canon includes an industry standard Adaptec PCI SCSI card suitable for PC users, to ensure wide compatibility and accelerated data delivery.

An optional Film Adaptor Unit (FAU) is available for the FB1200S, known as the FAU-S10. This incorporates a high luminance cold-cathode fluorescent lamp. Due to the quality of the optical system, the CanoScan FB1200S is able to provide a high Optical Density rating of 3.3D, which exceeds the rating of many dedicated film scanners.

The Canon CanoScan FB1200S is available now from Canon dealers and selected retail stores and has an RRP of $999. The FAU-S10 retails for $699. For more information contact Canon Australia on (02) 9805 2000.

Multimedia amp and speakers

The new Screenbeat Sound Station is the first multi-media speaker system to be compatible with Playstation and Dreamcast consoles. Its 300 watts (PMPO) subwoofer and twin satellite speakers give a new dimension to classic games, and is available in stylish iMac Blueberry or classic Purple.

Product Features include:

- Fully compatible with Sony PlayStaion, Sega, Dreamcast and PC
- 300 Watts PMPO
- 3-way sub-woofer speaker system
- Variable volume control
- Variable bass control
- Acoustically engineered cabinet
- Power supply included
- Accepts outputs from a Walkman, Discman, Mini Disc, MP3 Player etc.

For further information contact SpectraVideo (UK head office), 33 Northfield Industrial Estate, Beresford Avenue, Wembley, Middlesex HA0 1NW England, or visit **www.spectravideo.com**.

Compact data storage

Computer storage devices are becoming cheaper every year, even though they can now store much more information than previously. They are also becoming physically smaller and until recently, were built with a single computer system in mind. However, this is changing, and some storage systems are now becoming fully portable.

The SimpleDrive is a stylish mobile case that converts a portable hard drive into an external drive, making it the perfect partner for a hard drive upgrade. With so many computer users opting to upgrade their hard drives rather than buy a new PC, the question then arises as to what do you do with the old hard drive? The SimpleDrive allows you to turn it into an external drive that's as mobile and convenient as a portable computer.

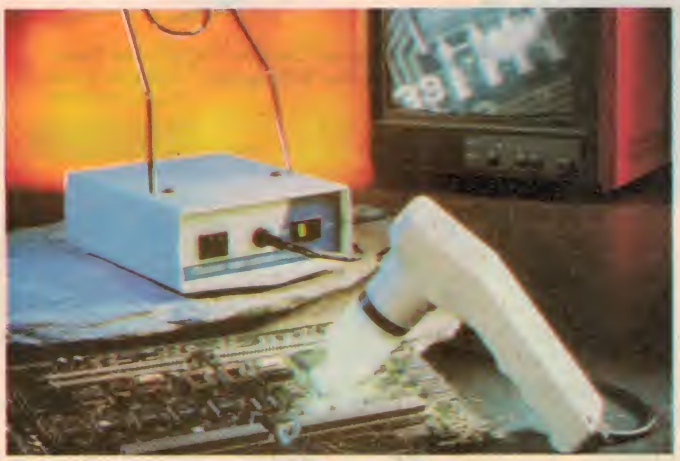
By plugging the SimpleDrive into the portable's parallel port or PCMCIA slot and attaching the power through the keyboard or PS/2 mouse port, the result is a second hard drive online that's fast enough to work from. For convenience, a black executive carrying case is included to transport all the necessary cables and driver software that comes with the SimpleDrive. The SimpleDrive provides a convenient solution to transporting important data between computers.

For more information visit WestGroup's web site at **www.westgroup.com.au** or call the WestGroup National Response Centre on freecall 1800 637 679.❖

NEW PRODUCTS

Components & Equipment

Video microscope for industrial use



The new Chroma model 7310 Video Microscope is a versatile CCD-based instrument which is ideally suited to applications including electronics manufacture, and in general for quality control in a broad range of fields.

Advanced DSP technology provides distortion-free images that avoid eyestrain, and permit multiple viewing. Frame freeze control and internal memory allow capture of single and multiple frames, either directly to video input of a TV, VTR, or to a PC equipped with image capture card.

Two illumination heads providing both contact and non-contact measurement are available for applications including top-angle and oblique-angle viewing. The large depth of field, combined with magnification range (four models to choose from ranging from 20X to 3000X) provide the maximum of operator comfort and versatility.

For further information, contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066.

DC-DC converter for 20-30V systems

Imark Communications has released the DC2412-20 DC-DC Converter, for industrial applications where it is necessary to operate 12 Volt DC equipment from a 20-30V DC power source such as truck and earthmoving equipment electrical systems.

The DC2412-20 uses switch-mode technology to provide typical 90% conversion efficiency and to conserve space (which is at a premium in today's downsized vehicles). It also uses a custom pressure die-casting that is more compact and is specifically designed for dissipation efficiency.

The converter operates from a vehicle's 24V DC electrical system and provides a 13.8V DC 10 amp continuous duty output. The input is protected against polarity reversal, while the output is over voltage and reverse polarity protected. Fold-back current limiting is provided and a thermistor controlled over temperature protection is included to switch the unit off in the event of the unit temperature exceeding 85°C.

Dimensions of the Imark DC2412-20 are 165 x 125 x 67mm and the weight is 1.55kg.

For more information contact Imark Communications, Unit 2, 75 Mark Street, North Melbourne, 3051

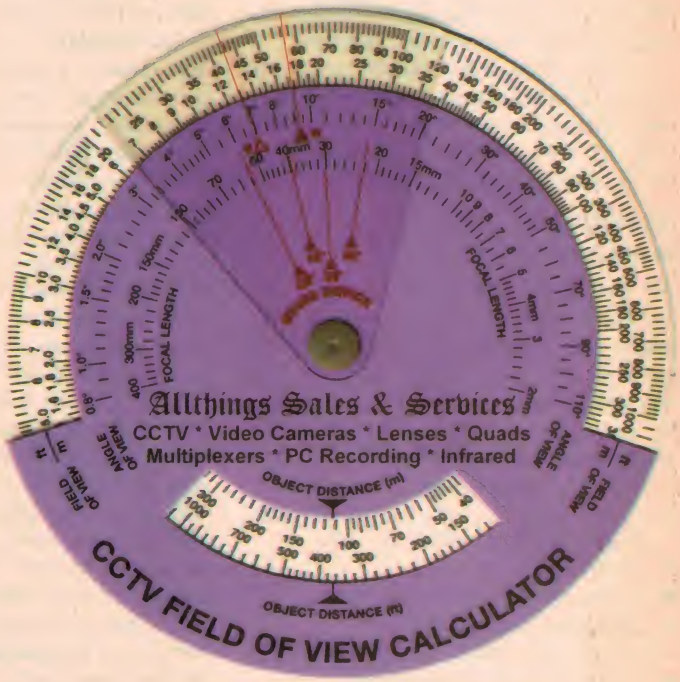
CCTV lens calculator

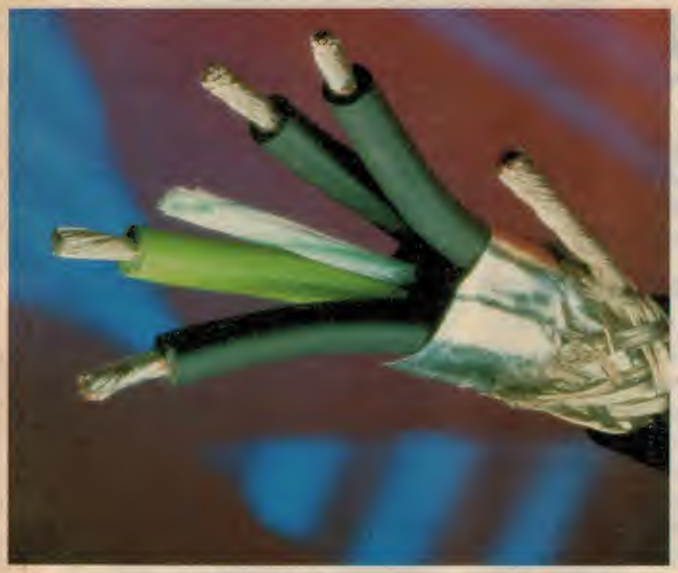
Now available from Allthings Sales & Services is a Closed Circuit Television Video Surveillance Lens Calculator, which allows quick, easy and error-free calculation of most commonly required parameters for CCTV Video Surveillance Cameras and lenses.

The horizontal and vertical Angle-of-View may be calculated for 2/3, 1/2, 1/3 and 1/4 inch image sensors, for all lens focal lengths between 2mm and 400mm. The vertical or horizontal Field-of-View (in metric or imperial units) may be calculated for any lens focal length between 2mm and 400mm, when used with any image sensor between 2/3 and 1/4 inch, for Lens to Object distances of 60mm to 500 metres.

The calculator includes an allowance of 10% on vertical and horizontal Field-of-View measurements to compensate for video monitor over-scan. An explanation of operation is printed on the back of the calculator.

Allthings Sales & Services have a limited quantity of this very popular and useful aid and they expect them to go quickly. Phone (08) 9349 9413, or visit **www.allthings.com.au**.





Cables for AC motor drives

Belden Australia has introduced a new line of cable for low-to-mid power variable-frequency AC motor drive applications. Belden Variable Frequency Drive (VFD) 600V shielded cable provides higher reliability, easier installation and cost benefits over metal clad cables or lead wire in conduit cables typically used for the type of demanding applications encountered by AC motor drive output cables.

Because VFD cables carry the power from AC drive systems to AC motors, they have been constructed to handle not only the overall high power levels of the pulse-width modulated (PWM) signals, but also the extremely high voltage that can occur when standing waves develop on the conductors. Conventional features include a thicker, more stable electrical insulation on the conductors that decreases the likelihood of a corona discharge as well as capacitance between conductors. In addition, an easy-to-install dual shield furnishes the lowest resistance ground path.

Belden VFD cables are 600V, UL 1277 Type TC-listed cables with four conductors (three signal and one ground). They are available with conductor sizes ranging from 16AWG (1.5mm2) for motors in the 0.37 to 7.46kW range up to 2AWG (35mm2) for motors in the 29.83 to 74.57kW range.

For more information contact Belden Australia on free call 1800 500 775, or visit **www.belden.com**.

Sub-mini counters, timers & panel meters

Danaher Controls has announced the Veeder-Root MicroMITE Series of sub-miniature counters, timers and panel meters, which deliver high performance at low prices. These tiny indicating devices, featuring terminals for panel and circuit board mounting and a remote reset input, are claimed ideal for space-constrained OEM applications, including medical and scientific device, small machinery, office equipment, and electrical monitors.

The MicroMITE counters come in three sizes, 17.5 x 27mm, 21 x 47mm and 24 x 48mm, and feature an easy-to-read LCD display, four-digit/6mm high, six-digit/6mm high, or eight-digit/8mm high. These uni-directional and bi-directional devices deliver count speed to 5kHz or 10kHz.

There are three Micro-MITE timers — two 21 x 47mm models offering four selectable time ranges, and one 24 x 48mm model that features a display backlight. All MicroMITE timers include an eight-digit, 8mm high LCD display, and are available with or without an automatic reset button.

MicroMITE panel meters, two 24 x 48mm models and two 36 x 72mm models, feature a 3.5 digit, 10 or 14mm high, LCD display with a backlight, common engineering units annunciators, and a panel mount bezel. Two of the models include an annunciator hold function and low battery indicator.

For more information contact Micromax, 307 Keira Street, Wollongong 2500. ❖

Letters to the Editor

A passion for electronics

As a first year electrical engineering student, I can see the reason behind your viewpoint in the September 1999 issue. In one of the units I am currently studying we have had numerous lectures from people outside the university. Nearly all of them stated about the workload and the extra hours that are put in by engineers.

I've had a keen interest in electronics since I was 12 (now 18) and have been getting issues of EA since 1994. I knew that I wanted to be an engineer since I was 14. As I once heard, its not just a hobby it's a passion.

It seems very few people have a passion for electronics. Electronics and its theory has always fascinated me. Students in high school only get a fraction of electronic theory before their senior years. Before you enter your senior you have to decide on a career path to choose your subjects appropriately. Since very little is taught in junior years (ohm's law), not many students get the chance to discover their inner passion for electronics.

Over the past 6 months I have learnt assembly and machine code programming (6802), logic systems, DC circuit analysis and many more things. If you think about the people who have shaped the world to what we know it as today and the ones who have ultimate control are electrical engineers.

Justin Mugford (via email)

Or is it love?

I think you missed a significant answer to the question "Who would want to be an engineer?" I think a driving force for many engineers is the simple fact that many of us like to tinker. As you've noted, you don't become an engineer for the glory nor money, so it's got to be for the love of it. Where else do you get paid to design and build cool stuff?

Your statement "we are in great danger of soon not having any engineers at all", I believe, is patently incorrect. The world will always need more engineers, it's just that they may not know it. The world is high-tech — it's what people seem to want and there's only one group of people who can give it to them: the scientists and engineers.

I've watched economics/law/etc. enrolments at my uni (Wollongong) rise over the past decade as students enrolled in the belief they'd make big bucks in the finance industry. More recently, a similar wave is rising with IT enrolments. But, fundamentally, unless you are in a career you enjoy, you're wasting your life. And let's face it, many people in the finance/IT/marketing industries just wouldn't cut it as engineers — best keep them where they can do the least damage :-)

Ben Low, BEng (via email)

Discouraged from studying

In the September issue, there were a few things which caught my attention. in the editorial, it was mentioned that there is little motivation to become an engineer. I completely agree with this, it seems that the industry and government encourages jobs like IT managers. I'm not saying that IT managers aren't important, but without design engineers, they'd have nothing to manage.

The main point that was emphasised was that commercial and government influences meant that more engineers were moving away from the field. I think that an important point needs to be added to this.

At this point in time, the government education policies seem to be against us too. As it stands, Engineering students pay more HECS than most other courses, and if you aren't from a rich family, you're better off not studying at all. I'll give you an example, if you go straight out of school to university, unless you have earned over $13000 in a 18 month period, you are still considered dependant, hence Youth allowance is dependant on your parents income. (and if you intend on doing well at school or uni, you don't have time to earn that much). If, on the other hand, you were to drop out, then look for work, you could go on the unemployed rate of youth allowance, which at times can be higher than the full time student's rate. Considering that students have much higher living expenses (i.e. text books, student fees etc.), this often discourages people from studying. What I'm trying to get at here is that, from a students point of view, it seems as if the government is trying to discourage people from taking up Engineering and other wealth creating careers. (don't forget about the enormous funding cuts, which has staff and resources hugely overloaded).

Phil Cole (via email)

Audio restoration software

As this magazine has had quite a few articles about audio restoration, I would like to expose a program that is available on the Internet. It is quite a useful tool for anyone interested in analogue audio restoration/preservation. Its name Sound Laundry does not do the program justice, as it is the most sophisticated program that I have found.

So far I have mainly played with its decrackle plug-in specifically for LP restoration and I must say I am extremely impressed. Every other program I have found from hours of Internet search has led me to conclude they are merely a fancy treble control on anyone's home stereo system. It appears Sound Laundry actually uses real computer technology to filter out the crackle on a record. I tried my most scratched record and the result was almost no crackle and full treble output.

The biggest drawback I found was the price for the full version, which I suppose, is not surprising for such a program. I got the demo off the producer's web site at **www.algorithmix.com**. Congratulations on a wonderful magazine. I have been a keen reader since grade seven and still receive great benefit reading them in my spare time between university study.

M. Duke (via email)

Are we that good?

Your website is excellent: attractive, highly readable, informative, interesting, easy to follow, clear and simple. Very few websites that I've visited are as good as yours.

I speak as a teacher.

Suleman Kesh (via email)

Early ionosonds

I was particularly interested in Geoff McNamara's article in the July 1999 issue about the IPS ionosonde installation on Macquarie Island and Richard Luckhurst's experiences during various upgrades.

I installed the 4B ionosonde on Macquarie in October/November 1983 while working for IPS. But the history of ionosondes on the island goes back much further than that.

An ionosonde was operated on Macquarie Island in the 1950s before it was destroyed by fire. A replacement sounder was promptly dispatched but it was dropped into the rough seas while being brought ashore. Some who had been inconvenienced by the interference from the ionosonde thought it was good riddance.

After that, Macquarie was without an ionospheric sounding station until November 1983. As described in Geoff's article, the site for the antenna mast and the 'garden shed' was on Wireless Hill on the north end of the island in an area known as Lambing Gully. This was a relatively sheltered spot on the east side of the hill where the gale force winds which blew much of the time were not so keenly felt.

The footings for the 20 metre mast and

the hut were poured with the aid of a helicopter while the ship *Nella Dan* lay at anchor. After the Nella had departed for Casey Station, the mast was erected with the use of an improvised 'gin pole' as the lifting gear had not made it to the island. The photo in the article of the IPS garden shed and mast looks remarkably like the installation in Lambing Gully.

It was certainly no holiday but a marvelous experience. Thanks for enabling me to relive it all.

Keith Gooley (via email)

DVD and CD-R

Why some DVD players can play CD-Rs and VCDs while others can't is not a mystery. I find most DVD players will play CD-R discs recorded from a PC. CD-R and CD-RW discs recorded from a delegated CD audio recorder will not play on most DVD players. CD and VCD operates from infra-red laser emitter at 780nm while DVD operates from a visible red laser emitter at 650nm.

DVD players with one laser emitter requires mechanical height adjustment in order to play the various media. With this design CD-R cannot be played. Players with dual laser emitters can play CD-R discs as it uses an infra-red emitter to play CDs and VCDs. Also with fixed laser emitter their reading accuracy is enhanced and reliability improved as there is no need to use a mechanical height adjusting unit for the laser emitter.

I found a number of DVD players with dual laser emitters, These are Sony DVP-S7700 and DVP-S715. The latter is now superseded by DVP-S525D and DVP-S725D. Both new models (DVP-S525D and DVP-725D) have a single emitter. The other dual laser emitters DVD player is Onkyo DV-S717. Philips claims their new models DVD 955 and DVD 950 will play CD-R and CD-RW discs and said to be the first player to be able to do so.

The tables will turn when Sony releases SACD. At this stage there is no indication that the present DVD players are compatible with SACD.

Michael Ong (via email) ❖

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PCB PATTERNS: High contrast, actual size transparencies for making PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, and $10 for larger boards. Please specify either positive or negative artwork when ordering.

PROJECT QUERIES: Advice on projects is limited to postal or email correspondence only and to projects less than ten years old. The price is $7.50. PLEASE NOTE that we cannot undertake special research or advise on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of the project advice detailed above, or submitted without fee, may be answered in the Information Centre pages at the discretion of the Editor.

READER SERVICES BULLETIN BOARD: Yes, we run a BBS as well. The number is (02) 9353 0627, and it is ANSI compatible, accessible 24 hours a day and supports any rate to 28.8kb/s.

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NOTE: All prices listed are in Australian dollars.

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PLEASE NOTE THAT WE ARE NOT ABLE TO OFFER A COUNTER SERVICE — Material is sent by mail only.

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☐ **Back issues**

Month:_____ Year: _____
Month:_____ Year: _____
Month:_____ Year: _____

☐ **Photocopies** ☐ **PCB artwork**

Article:_____

Month:_____ Year: _____

Article:_____

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☐ **Project query**

Article:_____

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Webwatch

BY GRAHAM CATTLEY

Due to popular request, I've collated a list of all the sites ever covered in Webwatch, and it is available for download from our web site in the Internet files section. You can save the file on your own system, and use it as a handy reference, and download the update every month. And if you know of any sites that you feel deserve a mention in Webwatch, drop me a line at gcattley@fpc.com.au, and I'll be happy to include them in an upcoming column.

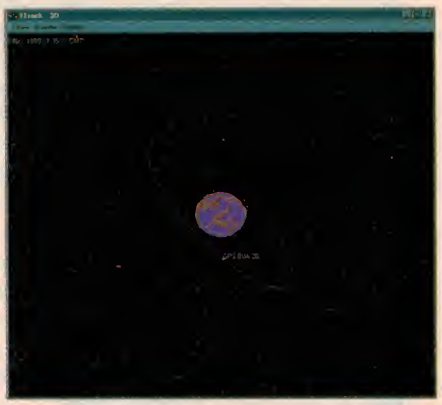
HOW BIG would you say a web sever is? How about the size of a matchhead? Yes, that's right, someone's managed to squeeze a whole web server into a tiny 8-pin 12C509A PIC, and just to keep the size down, they used the SO8 surface mount package too.

The chip runs at 4MHz, and implements a tiny TCP/IP stack, a HTTP 1.0 compliant web-server, and a simple telnet server (for editing files on the chip). Of course a web server on its own isn't much use to anyone without any files to serve, so they've attached a 24LC256 I2C EEPROM to hold up to 64 files.

These include 'The history of the world', and a couple of Java applets. There are supposed to be GIFs, JPGs, audio files as well, but I couldn't find them , but I was only looking at the mirror site. Why was I looking on the Mirror site? Because after all that, the world's smallest web server appeared to be broken...

Oh well, maybe they'll have it up and running again by the time you read this — have a look at **http://www.ccs.cs.umass.edu/~shri/iPic.html** and see if it is back on its feet again. (To be honest, I can't see that there is that much in the system to go wrong — after all, the whole thing only has three components...)

I WOULD HAVE TO SAY that **http://liftoff.msfc.nasa.gov/RealTime/JTrack/3D/JTrack3D.html** is the most impressive website I have ever seen. Well, it's not so much the website, but rather the Java app that loads in as soon as you access the page.



What you get is a real-time 3-D display of the position of over 500 satellites orbiting the Earth. Of course there are far, far more than 500 satellites up there, but this application shows only the 500 most popular ones to keep the processing down. You can zoom in or out, click on any satellite to see its orbit and ground paths, drag the viewpoint to see things from any angle, and even call up info on any of the satellites displayed. As I said, it is most impressive, and accurate too — satellite positional data is downloaded from NASA every time you log onto the site.

As an added bonus, you can also see where the ill-fated Mir space station is hanging in space, and even minute-by-minute plots of the Space Shuttle's path whenever it is flying.

If you have a Java enabled browser, this site is a must.

WANT TO SPRUCE UP your home stereo system? Then hop along to Martin Pickering's site at **http://www.netcentral.co.uk/satcure/audio/scam.htm**, where you can order some bidirectional oxygen free copper wire, special silicone lubricant to prevent your speaker's voice coil from rubbing on the magnet, or even a unidirectional filter to force electrons to travel one way up your speaker wires.

Its not until you hit the radioactive kaypak wool for speaker enclosures (to kill off bacteria that eat the speaker cones), that you realise that he isn't being exactly serious... Check it out.

IF YOU ARE MORE THAN SLIGHTLY interested in lasers, then you should really go and read Sam's Laser FAQ at **http://www.repairfaq.org/sam/laserfaq.htm** If you are a true Webwatch devotee, you'll recognise the first half of this URL. If you don't, head off to the sci.electronics.repair.FAQ Galactic Homepage at **http://www.repairfaq.org** to be, like totally, blown away.

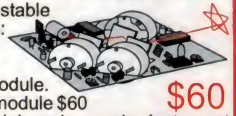
Back to lasers, though. Visible, invisible, Helium-Neon, Argon, Krypton, CO2, semiconductor, you name it, it's here.

Circuit diagrams, power supplies, PCBs and hundreds of photos are all here, along with standard warning labels and other support info. So if you have an urge to build a Helium-Mercury Laser in your living room, why not see how somebody else did it (and lived...)

IF YOU CAN BELIEVE what you see in the movies, old fashioned inventors would lock themselves away and struggle for weeks on end to get their latest gadget working.

Modern day inventors instead head off to the web for all their info, and if you fall into this latter category, then the Invention Dimension at **http://web.mit.edu/invent/index.html** is just the place for you. It is full of inventors and their inventions, from the ancient past through to today. You can read about the invention of air conditioning in 1911 by Mr Carrier, or the 'Glove and Battie Caddie' developed last year by 11 year old Austin Meggitt. As well, there is the online version of the Inventor's handbook, which covers everything a budding inventor should know about patents, intellectual property and so on. All up, a pretty good site. A bit American, but pretty good nonetheless...❖

NEW SUPER LOW PRICE + LASER AUTOMATIC LASER LIGHT SHOW KIT: MKIII. Automatically changes every 5 - 60 secs. Countless great displays from single to multiple flowers, collapsing circles, rotating single and multiple ellipses, stars, etc. Easy mirror alignment with "Allen Key". Kit inc. PCB, all on board components, three small DC motors, mirrors, precision adjustable mirror mounts: (K115) + very bright 650nM laser (LM2) module. Kit with laser module $60



$60

Kit + laser module + plug-pack + instument style case all at a special price of $75

12V Automotive Relays
with 30A SPDT Contacts (73 ohm relay coil). RRP $7. our price $4 ea. 4 for $12

ACTIVE (Amplified) SPEAKERS
Small Cheap plastic speakers that don't sound like small cheap plastic speakers. Philips brand. Fitted with a stereo 3.5mm plug, ready to plug into your sound card or portable radio. Req. 4 X AA batteries or 6V Plug-pack. Just $12

KEY-CHAIN LASER POINTER in a presentation box. Quality metal housing + 3X LR44 /AG13 bats. **FREE.** Extra bats. 50c Ea

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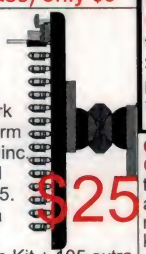
Line lens+$0.80...X-hair lens (+) $0.80...Module (no case) only $8

*****X-MASS SPECIAL*****
NIGHT VISION
35-140 LED INFRA-RED ILLUMINATOR KIT
Comes on when it gets dark or can be controlled by alarm system. 20-30M range Kit inc. mount ing tray & universal swivel mount. 35 LEDs $25. Extra 35 LED pack (3extra packs max) $14 per pack. 140 LED kit: $67 **OR** base Kit + 105 extra LEDs, **140 LEDs TOTAL!!!** for just $50. Use with B/W cameras to see in the dark.



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USED AUSSIE MADE TRANSFORMER
240V PRIMARY (120+120),ES screen, Secondary....1X12V@1.1A...10V@5A...7 V@ 5A... 12-0-12V@7.5A. 100 X 115 X 100mm. bargain at $15

NEW FULLY FEATURED ANSWERING MACHINES. Brand new in original box with manual, tape, plug pack and phone lead Call screening, up to 2.5 min. out going message, VOX recording, power fail protection, memo record, plays music before beep, digital volume control, programable security code, remote call breakthrough, room monitor, full remote features, save messages, AUSTEL approved. Bargain priced at $25

$25

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Sorry but we don't have one but if you call **02-95843564** 24hrs & leave a message & your number we will call you back ASAP at our cost. NO MOBILES. STD AND NZ. OK **(ORDERS ONLY)**

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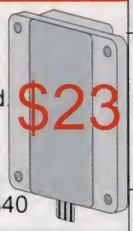
****NEW**NEW**NEW****
CHRISTMAS SPECIAL
FLASHING MOBIE ANTENNAS
To suit most popular mobile phones.
1 / 3 LED (RGB) $3.50 / $7.00

****LOOK AT THIS****
12 & 24 VDC 10W-13W CFLs for around $24
Ideal for solar systems, caravans, safety lead light for car repair workshops etc.

****NEW PRODUCT****
BRAND NEW MICROWAVE DOPPLER TRANSCEIVER (movement detector) 5VDC operation @ 50mA. Operates at 10.525 GHz. can be pulse mode operated Uses include alarms, radar experimentation, automatic doors, obstruction detection for vehicles and robots etc. and lighting control as you enter or leave a room. Super special introductory price of $23or 2 for $40



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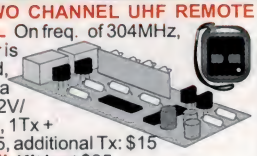
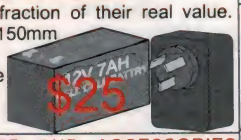
SOLAR PANEL / FAN COMBINATION SPECIAL
Quality SEIMENS brand Polycrystallinecells. Voc Isc 1W output. 4 panels req. to charge 12V batteries. Specifications: Open circuit voltage: 5.7v...Short circuit current: 0.22A Peak Power: 1.0W @ 100mW / sq cm. 160mm x 55mm x 5mm...Flying lead: Dual cable 25cm . Should be placed under glass for outdoor use.$10ea. or 4 for $36...
PANAFLOW brand 60mm 12VDC FANS. $3 Ea OR 4 FOR $10
Or 1Fan + 1 Solar Panel for thecombined bulk prices... $11.50...One of these solar panels will run one of these fans in overcast conditions.

ONE / TWO CHANNEL UHF REMOTE CONTROL On freq. of 304MHz, transmitter is assembled, receiver is a kit, inc. 2 12V/ 12A relays, 1Tx + 1Rx kit:$45, additional Tx: $15 **I CHANNEL Kit just** $25



WE HAVE FRESH STOCKS OF NEW 12V / 7Ah GEL BATTERIES
Priced at a fraction of their real value. 65mm (W) X 150mm (L) X 94mm (H),+ suitable trickle charger.



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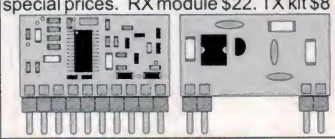
CAMCORDER AND ACCESSORIES NiCad. BATTERIES 6V 2400mAh. Multi-fit type. These are new and in original pack. Two types. One type (sbc5223) fits CANON, BAUER and equivalent. The other (sbc5225) fits HITACHI, SABA, MINOLTA, RCA and equivalents. Just a fraction of the retail price at $30

NEW AUSTRALIAN PLUG PACKS AT BELOW WHOLESALE PRICES
GENERAL ELECTRIC 20VA 14VDC @ 700mA.
AUDIOVOX 9V @ 500mA
AUDIOVOX 12V @ 400mA....
$5 Ea. or 5 for $20

RADIO CONTROL MODEL SPEED CONTROL KIT
This kit is designed to work direct from a STD 1-2ms pulse from a R/C receiver to control an electric motor (in one direction only). Kit includes PCB + all on-board components inc. 5 high power MOSFETs, a wiring kit and fuse holder & 26 x 64 x 38mm case. Features include brake. Don't pay $150 for commercially available one Coming soon for less than $35

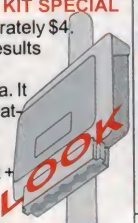
< $35

... DATA TRANSMISSION
Stamp sized Xtal locked 433.9MHz superhetrodyne receiver module. Small matching transmitter kit:(K122) All at special prices. RX module $22. TX kit $8



ALCOHOL BREATH TESTER KIT:
Ref: EA Oct. 96. Based on a high quality Japanese thick film alcohol gas sensor. The kit includes a PCB, all on board components and a meter movement: (K80) redused from$40 to &25

MASTHEAD AMPLIFIER KIT SPECIAL
The MAR-6 available separately $4. The amplifier gives good results with any two metal wires or strips acting for the antenna. It should even work with a coat-hanger! Basic kit with both the PCBs & all on-board parts (K03) $15 ...Basic Kit + 2 Weather-proof Plastic Boxes + plug-pack: $20
(ask for your free case with this item)

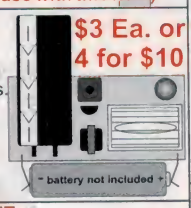


LOOK

XENON FLASH TUBES
Removed from disposable cameras. Just add a AA cel.

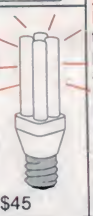
$3 Ea. or 4 for $10

STROBE KIT also available. uses above flash$6



~ battery not included ~

CFL INVERTER KIT
our very popular inverter. The improved design uses a larger transformer and a SG3525 switch Mode Chip.This very Efficient Driver kit can drive a number of CFL's from 12vdc. & would be great for lighting the weekender or caravan..
SPECIAL 1 inverter & 3 CFLs: $45



PELTIER EFFECT DEVICES.
Could be used for cooling overclocked PC CPUs. All 40 X 40mm.
4A △ T 65deg. Qmax 42W $25
6A △ T 65deg. Qmax 60W $27.50
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Comes with info to build cooler / heater plus data. Some used heatsinks avail.

TWO MOTOR LASER LIGHTSHOW KIT
Inc. motors, mirrors, reversing switch & all electronic components. Can be controlled by variable DC input. Lots of patterns, flowers, stars etc. $16 **Laser module $8**

5KHz OSCILLOSCOPE $25!!!
Ref EA Aug. 96. Kit Connects to your PC parallel port & samples over 0-2V & 0-20V @ between1 per hour to 1per 100uS. Ideal to monitor battery charging etc. or used as a basic 5KHz oscilloscope! Our kit inc. all onboard com-ponents, PCB, box & software on 3.5 disk:(K90) $25

12V SOLAR REGULATOR KIT
Our new regulator suits up to 100W panels. Features a current limiter so it can be used with car battery chargers, generators etc. Low cost due to the use of some unused recycled components. complete kit inc. case $29... See our bargain solar panels in this ad..

MUSIC BOX KIT:
Ref: EA Oct. 96. This little kit is the electronic equivalent music box. With a range of tunes & is activated by light Use it in a music box, a musical jewellery case, or toys. Req. 2 x AA batteries. Kit is supplied with PCB, all on-board components, a small speaker and battery holder. Kit is available in two different versions;
*Xmas Songs + M3481 IC: (K78C) $11
*Various Songs + M3485 IC: (K78V) $11
* Additional (M3481 or M3485) $3.50 each

UHF AUDIO / VIDEO TRANSMITTER KIT
Kit includes all components needed.....
PCB plus all on-board components, connectors, switch, metal case, telescopic antenna, twin RCA A/V lead, all that is needed to complete the full kit. 12Vdc @10mA operation. Ideal for transmitting audio and video around you home.. Complete Kit for just $28

suitable plugcack $5

VIDEO CAMERAS
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ALL WITH A FREE VHF MODULATOR & SUITABLE PLUG PACK

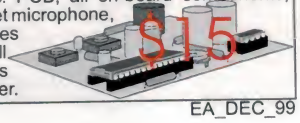
$160 $70

MODEM MADNESS
Why buy a fast modem when it is rare to log on at the maximum speed. We have 28.8 modems that come with a free CD rom / free 30 hour internet connection to BIG POND.

$25

Approved. 9Vac plug pack required. (not supplied)

20-30 SECOND SOUND / VOICE RECORDER KIT. This kit could be used to take messages at your door or as a personal reminder device & is easy to assemble. Good quality sound at 25 sec, Uses LS I chip with memory etc. all built in. Kit inc. PCB, all on-board components, electret microphone, switches & small surplus speaker.



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